

[54] **COMPUTER-DIRECTED PROCESS  
CONTROL SYSTEM WITH INTERACTIVE  
DISPLAY FUNCTIONS**

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[75] Inventor: **Nicholas O. Cromwell, Sharon,  
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[73] Assignee: **The Foxboro Company, Foxboro,  
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*Primary Examiner*—Harvey E. Springborn  
*Attorney, Agent, or Firm*—Parmelee, Johnson &  
Bollinger

[22] Filed: **Aug. 13, 1975**

[21] Appl. No.: **604,092**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 481,180, June 20, 1974,  
which is a continuation of Ser. No. 419,444, Nov. 27,  
1973, which is a continuation of Ser. No. 229,077,  
Feb. 24, 1972.

[52] U.S. Cl. .... **340/172.5; 340/324 A**

[51] Int. Cl.<sup>1</sup> ..... **G06F 3/14**

[58] Field of Search ..... **340/172.5, 324 A, 324 AD;  
445/1**

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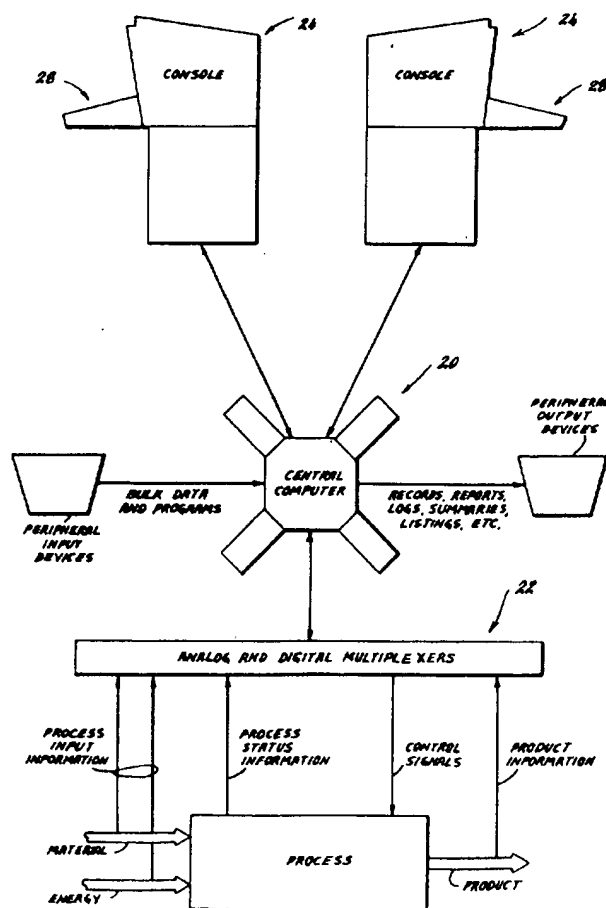
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[57] **ABSTRACT**

An industrial process control system including a digital computer arranged in a time-share configuration to perform calculations respecting a plurality of process conditions, and to produce corresponding command signals for respective process operators such as valves and the like. The system includes an operator's console unit having a CRT display controlled by a local memory controllable by a keyboard, and by the computer in response to action from the keyboard. Special process-oriented displays can be presented on the CRT, such as fill-in-the-blanks forms into which the operator can insert new values, or other information. The keyboard includes a number of distinctive function keys which serve, in cooperation with the special CRT displays, to present information to the computer for processing, to aid in controlling the process.

**11 Claims, 23 Drawing Figures**



- [54] INDUSTRIAL COMMUNICATIONS NETWORK WITH MASTERSHIP DETERMINED BY NEED
- [75] Inventors: Raymond A. Grudowski, South Euclid; Jonathan R. Engdahl, Maple Heights, both of Ohio
- [73] Assignee: Allen-Bradley Company, Milwaukee, Wis.
- [21] Appl. No.: 102,970
- [22] Filed: Dec. 12, 1979
- [51] Int. Cl.<sup>3</sup> ..... G06F 3/00
- [52] U.S. Cl. .... 364/900
- [58] Field of Search ... 364/200 MS File, 900 MS File
- [56] References Cited

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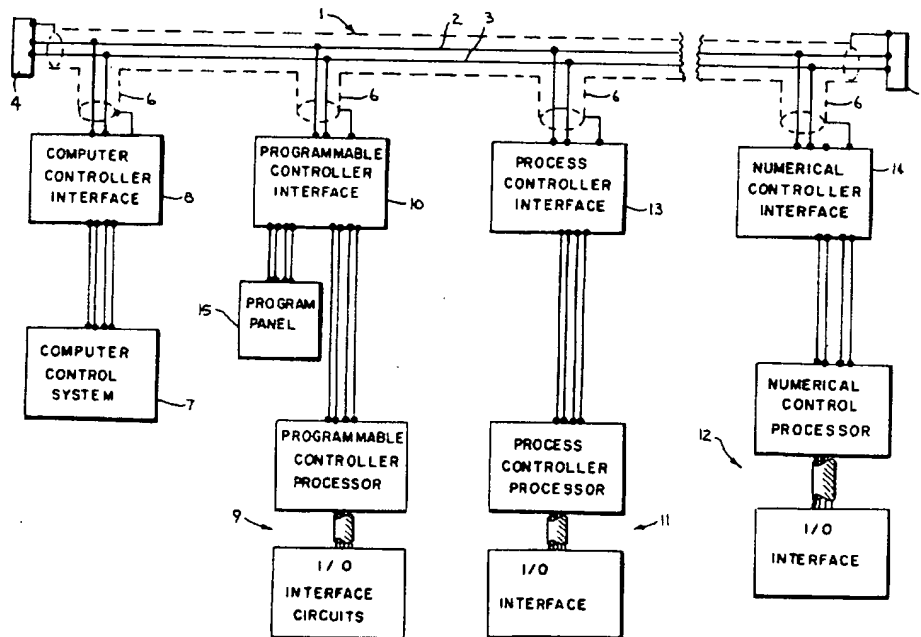
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Primary Examiner—Raulfe B. Zache  
Attorney, Agent, or Firm—Quarles & Brady

[57] ABSTRACT

An industrial communications network includes micro-processor-based interface circuits which each connect a controller such as a programmable controller to a high speed serial data link. Each interface circuit connects to the data link and its associated controller, and each is operable to receive messages on the data link directed to its associated controller. In addition, each interface circuit can assume mastership of the communications network when the existing master generates a poll command indicating it is ready to relinquish mastership. As a result, the communications network will continue to function even though one or more controller or their associated interface circuits become inoperable.

16 Claims, 17 Drawing Figures



# United States Patent [19]

Agarwal

[11] Patent Number: 4,688,167

[45] Date of Patent: Aug. 18, 1987

## [54] SCREEN MANAGER FOR DATA PROCESSING SYSTEM

[75] Inventor: Arun K. Agarwal, Chelmsford, Mass.

[73] Assignee: Wang Laboratories, Inc., Lowell, Mass.

[21] Appl. No.: 655,280

[22] Filed: Sep. 27, 1984

[51] Int. Cl.<sup>4</sup> ..... G06F 3/14

[52] U.S. Cl. .... 364/200; 340/734; 340/747

[58] Field of Search ... 364/200 MS File, 900 MS File, 364/300; 340/709, 712, 734, 735, 747

## [56] References Cited

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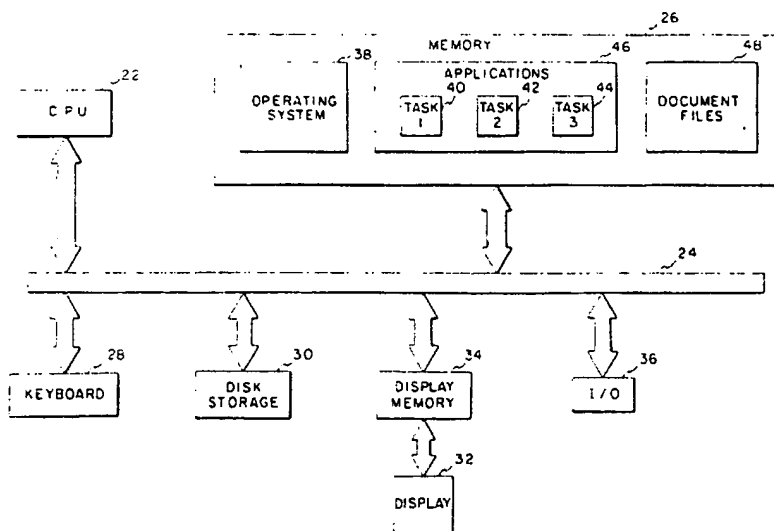
play", IBM Tech. Disc. Bull. vol. 20, vol. 10, 3/78, pp. 4148-4151.

Primary Examiner—Raulfe B. Zache  
Attorney, Agent, or Firm—Michael H. Shanahan; Gary D. Clapp

## [57] ABSTRACT

In a multi-tasking data processing system, each task may request that the operating system set up descriptor blocks which identify virtual screens for display of data on the video display. Under keyboard control, only one virtual screen is selected for display at a given time. The operating system reserves a portion of the video display for displaying identifiers of the virtual screens which have been established but which are held in background. Each virtual screen may be subdivided into viewports by the corresponding application task. Those viewports are also identified in the operating system by descriptor blocks which point to pages of data in the document files. The descriptor blocks can be modified through requests from application tasks even when held in background. Whenever the display memory is updated, data designated by the descriptor blocks is passed through a rasterizer in the operating system which generates the pixel data to be stored in a display memory.

43 Claims, 11 Drawing Figures



# United States Patent [19]

Anthias et al.

[11] Patent Number: 4,845,644

[45] Date of Patent: Jul. 4, 1989

## [54] DATA DISPLAY SYSTEM

[75] Inventors: Tefcros Anthias, Romsey; John A. Herrod; Martin W. Ricketts, both of Eastleigh, all of United Kingdom

[73] Assignee: International Business Machines Corporation, Armonk, N.Y.

[21] Appl. No.: 59,881

[22] Filed: Jun. 9, 1987

### [30] Foreign Application Priority Data

Jun. 16, 1986 [GB] United Kingdom ..... 8614618

[51] Int. Cl.<sup>4</sup> ..... G09G 1/00; G09G 1/16

[52] U.S. Cl. .... 364/521; 340/729; 382/44

[58] Field of Search ..... 364/518, 521; 382/44-45; 340/721, 724, 729

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Primary Examiner—Gary V. Harkcom

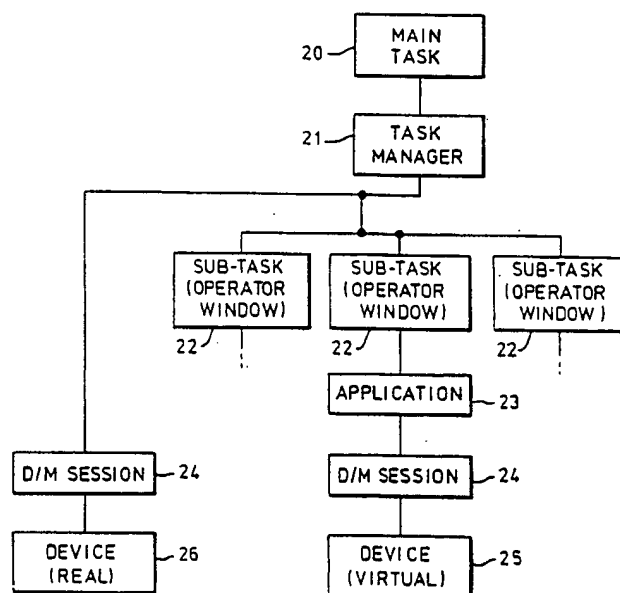
Assistant Examiner—H. R. Herndon

Attorney, Agent, or Firm—Marc D. Schechter

### [57] ABSTRACT

A data display system in which input-output display devices are connected to a central processor, and users select application programs that are run on the central processor. The control system of the central processor includes a display manager control system and a windowing control mechanism which allows a plurality of tasks to be performed concurrently and the results displayed in areas of a display screen. The windowing control mechanism includes, a task manager control program which runs as an application in the display manager control system and includes means to interact, via the display manager, with the operator to allow applications to be initiated, means to create tasks to control the processing of the application in such a way that the applications can be suspended or resumed according to whether the operator is ready for them, and means to identify to the display manager a coordination controller that the display manager can call to allow the task manager to suspend and resume applications. The display-manager includes, means to combine data from each application and build a display representation that shows many windows into the various applications onto a single screen, and means to call the coordination controller identified by the task management application so that the task manager can suspend applications that are waiting for input and resume those applications which have input available.

10 Claims, 2 Drawing Sheets



[54] OPERATOR ACCESS TO MONITORING APPLICATIONS

[75] Inventor: Mark W. Estes, Dallas, Tex.;  
Harold H. Hall, San Jose, Ca.

[73] Assignee: International Business Machines Corp., Armonk, N.Y.

[21] Appl. No.: 6,514

[22] Filed: Jan. 23, 1987

[51] Int. Cl.<sup>4</sup> ..... G01F 15/06

[52] U.S. Cl. .... 364/550; 364/521;  
364/138; 364/185; 340/721

[58] Field of Search ..... 364/550, 551, 518, 521,  
364/900, 138, 139, 146, 178, 179, 184, 185, 188,  
194; 340/720-722, 747, 701

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Primary Examiner—Parshotam S. Lall

Assistant Examiner—Brian M. Mattson

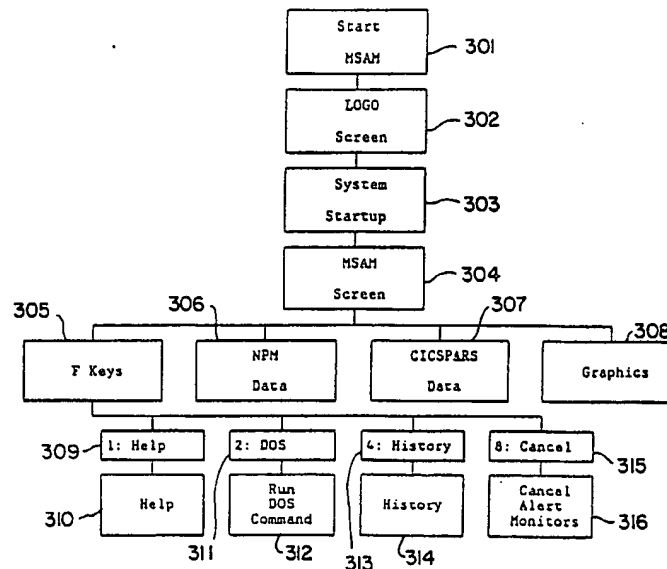
Attorney, Agent, or Firm—C. Lamont Whitham;

Michael E. Whitham

[57] ABSTRACT

Information from multiple CICS host applications is gathered and the information is displayed on a single display screen. The information includes graphics, reports, and monitoring information. The display screens that the user is presented with are in a format that correspond to the host display screens that are commonly employed in large data processing (DO) centers. A host based status array is used to minimize the overhead of the communications between the host and the PC. The IBM 3270-PC or other microprocessor with a host communications interface receives existing, summarized information and reduces the information to a complete, accurate picture of the multiple applications that enables the operator to have timely information and respond effectively in a complex DP environment. The alarm information is organized to effectively call the operator's attention to a key problem quickly and efficiently. Key alarm messages can be designated as voice messages which are automatically translated and output as synthesized voice alerts. Threshold conditions can be called to the operator's attention by specifying tolerances, that once exceeded, trigger an electronic tone of designated frequency and duration.

10 Claims, 47 Drawing Sheets



# United States Patent [19]

Janke et al.

[11] Patent Number: 4,897,777

[45] Date of Patent: Jan. 30, 1990

[54] **PEER-TO-PEER REGISTER EXCHANGE  
CONTROLLER FOR PLCs**

[75] Inventors: Donald R. Janke; Kim J. Watt, both  
of Milwaukee, Wis.; Dirk I. Gates,  
Woodland Hills, Calif.

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 179,674

[22] Filed: Apr. 11, 1988

[51] Int. Cl.<sup>4</sup> ..... G06F 15/46; G06F 15/16

[52] U.S. Cl. .... 364/134; 364/140;  
364/900; 364/926.9; 364/949; 364/931.4;  
364/942.1; 364/951

[58] Field of Search ..... 364/131-136,  
364/140-147, 200 MS File, 900 MS File

[56] **References Cited**

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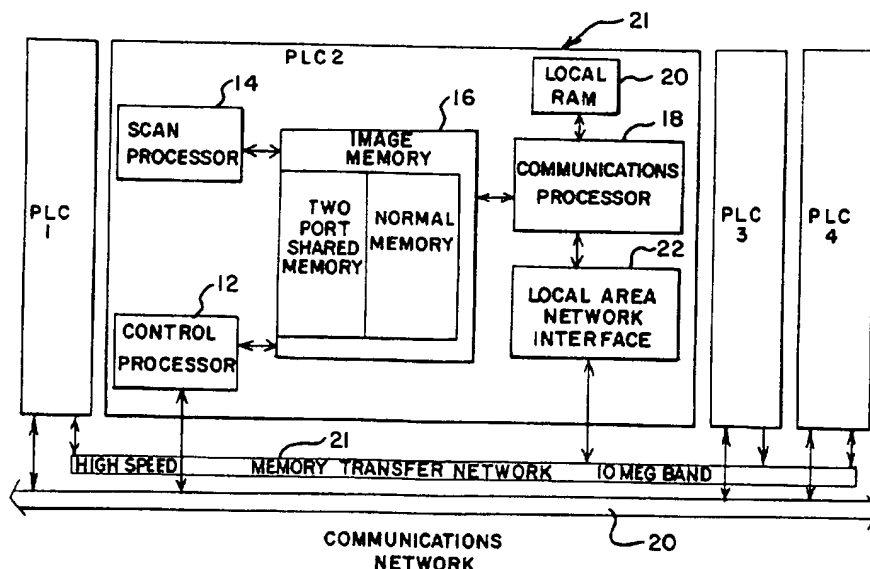
Primary Examiner—Joseph Ruggiero

Attorney, Agent, or Firm—Michael J. Femal; Thomas K. Stine

[57] **ABSTRACT**

A communication network for programmable logic controllers (PLCs) wherein selected memory means of each PLC have at least two ports directly accessible by other PLCs and certain registers of the PLCs are identical to enable efficient, high-speed transfer of blocks of data between the PLCs.

13 Claims, 2 Drawing Sheets



[45] **Date of Patent:** Mar. 27, 1990

**United States Patent** [19]  
**Flood et al.**

[11] **Patent Number:** **4,937,777**  
[45] **Date of Patent:** **Jun. 26, 1990**

- [54] **PROGRAMMABLE CONTROLLER WITH MULTIPLE TASK PROCESSORS**  
[75] **Inventors:** **Mark A. Flood; Michael D. Kalan,** both of Mayfield Heights; **Peter N. Preis,** Lyndhurst, all of Ohio; **Alden L. Peterson,** Brooklyn, N.Y.  
[73] **Assignee:** **Allen-Bradley Company, Inc.,** Milwaukee, Wis.  
[21] **Appl. No.:** **105,815**  
[22] **Filed:** **Oct. 7, 1987**  
[51] **Int. Cl.:** ..... **G05B 19/00**  
[52] **U.S. Cl.:** ..... **364/900**  
[58] **Field of Search** ..... **364/900, 200**

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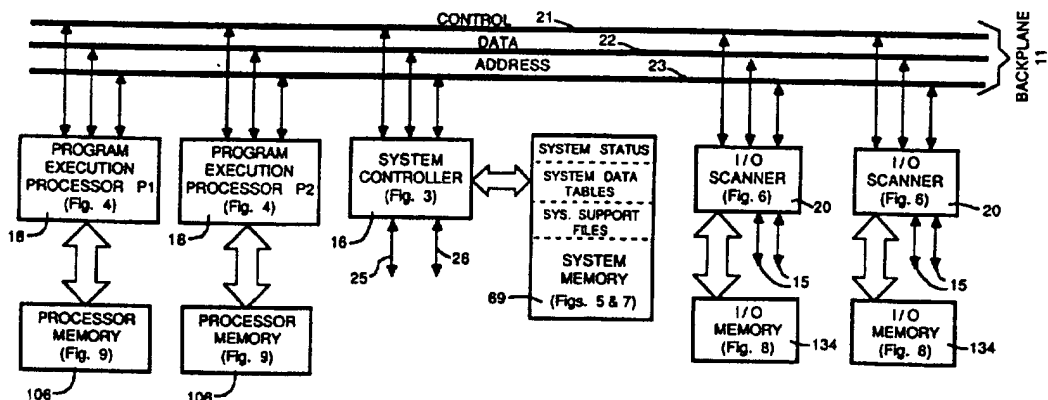
**Primary Examiner—**Andrew J. James  
**Assistant Examiner—**Viet Q. Nguyen  
**Attorney, Agent, or Firm—**Quarles & Brady

[57] **ABSTRACT**

A programmable controller for operating a machine to carry out programmed functions includes a plurality of program processors. Each of the program processors is operable to execute simultaneously a different user control program that directs the operation of the machine to perform specific functions. Each of the program processors includes a memory for storing the user control programs and function chart data. The function chart data comprises a series of descriptor files each of which contain an identification of a user control program to execute, a transition condition that indicates when the execution of that user control program is to terminate, and which descriptor file is to be processed next as well as the program processors to process it. A mechanism is also provided to enable the program processors to execute other programs in as background tasks without adversely affecting the execution of the control programs.

**9 Claims, 16 Drawing Sheets**

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**United States Patent** [19]  
**Hollander et al.**

[11] **Patent Number:** **4,949,274**  
[45] **Date of Patent:** **Aug. 14, 1990**

[54] **TEST METERS**

[75] **Inventors:** **Milton B. Hollander; William E. McKinley, both of Stamford; James P. Crimmins; Ian K. Storer, both of Westport, all of Conn.**

[73] **Assignee:** **Omega Engineering, Inc., Stamford, Conn.**

[21] **Appl. No.:** **312,880**

[22] **PCT Filed:** **May 18, 1988**

[86] **PCT No.:** **PCT/US88/01648**

§ 371 Date: **Oct. 31, 1988**

§ 102(e) Date: **Oct. 31, 1988**

**Related U.S. Application Data**

[63] **Continuation-in-part of Ser. No. 53,385, May 22, 1987, abandoned.**

[51] **Int. Cl.:** **G01R 19/00**

[52] **U.S. Cl.:** **364/483; 364/131; 364/513.5; 324/99 D**

[58] **Field of Search:** **364/481, 483, 550, 551.01, 364/709, 710, 131, 132, 513.5; 324/99 D, 76 R, 73 R, 115; 307/152; 381/51; 328/132; 340/661, 662, 663**

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*Primary Examiner*—Parshotam S. Lall

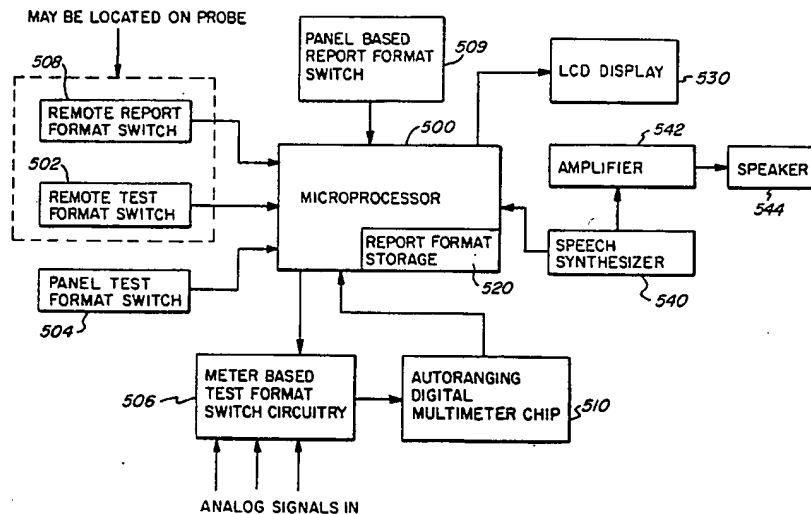
*Assistant Examiner*—Ellis B. Ramirez

*Attorney, Agent, or Firm*—Bruce E. Hosmer

[57] **ABSTRACT**

Test meters, particularly of the type employed for testing electrical circuits, e.g. multimeters, are improved in operational efficiency. In one aspect, remote selection of test and/or report format frees the operators hands for concentration on a test piece. In another test results or format information are conveyed as synthesized speech in any of a number of selectable formats. By combining both aspects in a hand-held multimeter, a high degree of interaction between the operator and the meter is achieved.

**24 Claims, 10 Drawing Sheets**



[54] FUNCTION-DISTRIBUTED CONTROL APPARATUS

[75] Inventors: Masatsugu Kametani, Ibaraki; Kengo Sugiyama, Abiko; Takashi Kogawa, Sakura, all of Japan

[73] Assignee: Hitachi, Ltd., Tokyo, Japan

[21] Appl. No.: 215,805

[22] Filed: Jul. 6, 1988

[30] Foreign Application Priority Data

Jul. 8, 1987 [JP] Japan ..... 62-168704

[51] Int. Cl.<sup>5</sup> ..... G06F 15/46; G06F 15/16

[52] U.S. Cl. .... 364/132; 364/134;  
364/200; 364/222; 364/230.4; 364/900;  
364/921; 364/931.44

[58] Field of Search ..... 364/131-136,  
364/200 MS, 900 MS, 140-147

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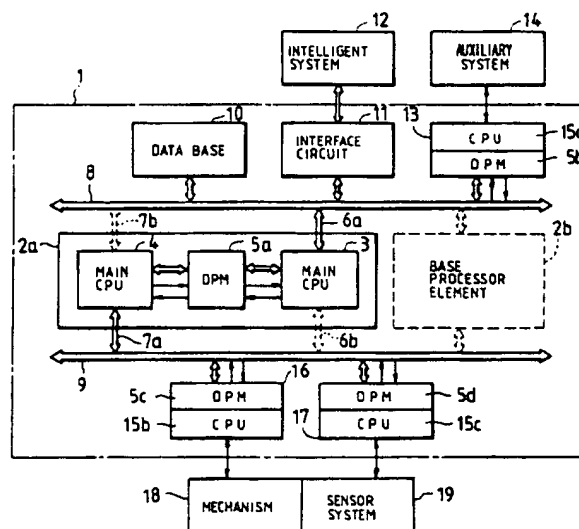
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Primary Examiner—Joseph Ruggiero  
Attorney, Agent, or Firm—Antonelli, Terry, Stout & Kraus

[57] ABSTRACT

A function-distributed control apparatus comprises a first bus, a second bus, and at least one base processor element which includes a first main processing unit connected to at least the first bus, a second main processing unit connected to at least the second bus, and a dual-port memory with a mutual interrupt circuit connected to both these main processing units for communications between them. The first bus and the first main processing unit are chiefly for intelligent processing required for controlling a machine, while the second bus and the second main processing unit are chiefly for motion control of the machine. Those buses are also connected to various intelligent subsystems each including a processing unit and a dual-port memory with a mutual interrupt circuit for communications with the base processor element.

17 Claims, 3 Drawing Sheets



# United States Patent [19]

Janke et al.

[11] Patent Number: 4,992,926

[45] Date of Patent: Feb. 12, 1991

## [54] PEER-TO-PEER REGISTER EXCHANGE CONTROLLER FOR INDUSTRIAL PROGRAMMABLE CONTROLLERS

[75] Inventors: Donald R. Janke; Kim J. Watt, both  
of Milwaukee, Wis.; Dirk I. Gates,  
Woodland Hills, Calif.; Joseph T.  
Bronikowski, Brown Deer, Wis.

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 258,779

[22] Filed: Oct. 17, 1988

### Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 179,674, Apr. 11,  
1988, Pat. No. 4,897,777.

[51] Int. Cl.<sup>3</sup> ..... G06F 15/46; G06F 15/16

[52] U.S. Cl. .... 364/134; 364/140;  
364/900; 364/926.9; 364/931.4; 364/942.1;  
364/949; 364/951

[58] Field of Search ..... 364/131-136,  
364/140-147, 138, 200, 900; 370/85.1-85.15,  
94.1, 94.2, 101; 340/825.05-825.08, 825.14,  
825.2, 825.22, 825.51, 825.52

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Primary Examiner—Joseph Ruggiero

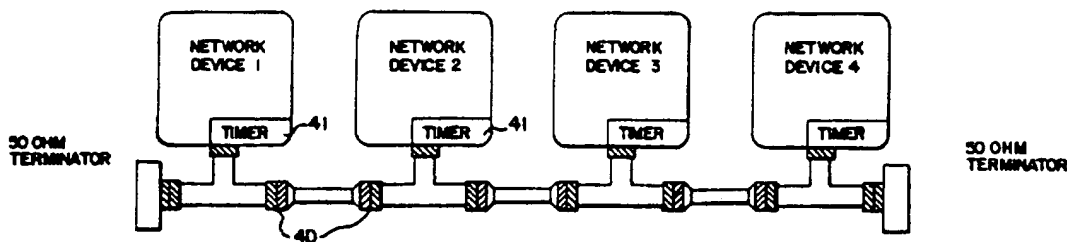
Attorney, Agent, or Firm—Michael J. Femal; Thomas K.  
Stine

## [57] ABSTRACT

A communication network for programmable logic controllers (PLC) wherein selected memory means of each PLC has at least two ports directly accessible by other PLC and certain registers of the PLC are identical. Each PLC further has an interblock gap timer to signal the PLC when its transmit time slice is to occur. The time slice consists of a block transmit time and an interblock gap time. The total update time has been optimized to enable efficient, high-speed transfer of blocks of data between the PLCs.

8 Claims, 3 Drawing Sheets

### NETWORK CONNECTION



**United States Patent** [19]  
**Akiyama**

[11] **Patent Number:** **5,012,402**

[45] **Date of Patent:** **Apr. 30, 1991**

[54] **SYSTEM FOR MODIFYING A MACHINE'S  
PROGRAM AT A REMOTE LOCATION**

[75] **Inventor:** Yasuo Akiyama, Kyoto, Japan

[73] **Assignee:** Murata Kikai Kabushiki Kaisha,  
Kyoto, Japan

[21] **Appl. No.:** 285,508

[22] **Filed:** Dec. 16, 1988

[30] **Foreign Application Priority Data**

Dec. 17, 1987 [JP] Japan ..... 62-317478

[51] **Int. Cl.<sup>3</sup>** ..... G06F 15/46

[52] **U.S. Cl.** ..... 364/192; 364/138;  
364/474.11; 340/825.23

[58] **Field of Search** ..... 364/138, 192, 474.11,  
364/132, 200, 900, 300; 340/825.06, 825.22,  
825.23, 825.29

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*Primary Examiner*—Clark A. Jablon

*Assistant Examiner*—Paul Gordon

*Attorney, Agent, or Firm*—Spensley, Horn, Jubas &  
Lubitz

[57] **ABSTRACT**

A system for controlling a machine at a remote place is constituted such that, when repairs and a change of a mechanical part of an apparatus on the remote place side are performed and changing of a program for a programmable sequencers for driving and controlling the apparatus is performed, contents of a change of the program thus performed are sent to a computer on the main office side and checked and changed on the main office side to make a correct program, and the correct program is sent to the controlling device on the remote place side.

**5 Claims, 1 Drawing Sheet**

**United States Patent** [19]  
**Siverling**

[11] **Patent Number:** **5,023,770**  
[45] **Date of Patent:** **Jun. 11, 1991**

[54] **HIGH-SPEED PRESS CONTROL SYSTEM**  
[75] **Inventor:** Erich H. Siverling, Wauwatosa, Wis.  
[73] **Assignee:** Square D Company, Palatine, Ill.  
[21] **Appl. No.:** 179,743  
[22] **Filed:** Apr. 11, 1988  
[51] **Int. Cl.<sup>5</sup>** ..... G06F 9/00  
[52] **U.S. Cl.** ..... 364/140; 364/147  
[58] **Field of Search** ..... 364/140, 141, 146, 147,  
364/136

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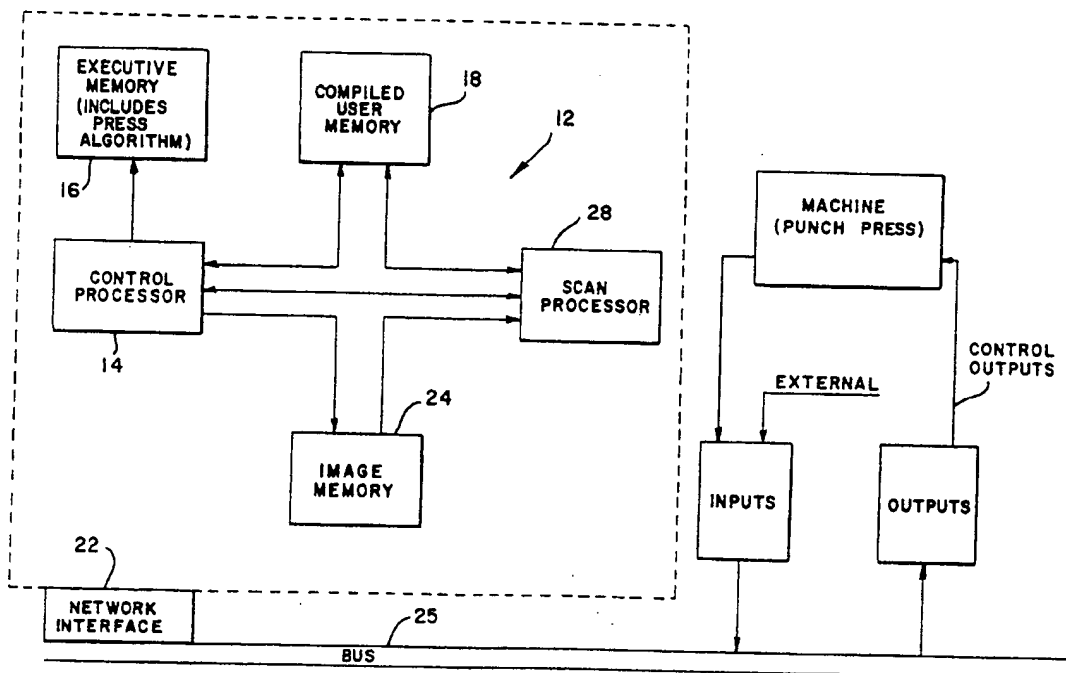
*Primary Examiner*—Allen R. MacDonald  
*Attorney, Agent, or Firm*—Michael J. Femal; Thomas K. Stine

[57] **ABSTRACT**

A high-speed press control system including a control processor and an associated scan processor for executing a press algorithm providing timed interrupts and consisting of identical programmable sub-algorithms to control output and input registers. The high-speed press control system has the capability of monitoring and reacting to press position every 2.5 ms.

**8 Claims, 4 Drawing Sheets**

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## [54] FLEXIBLE DATA DISPLAY

[75] Inventors: Timothy T. Phillips, Edgewood;  
Deborah C. Cummings, Villa Hills;  
Emily S. Divita, Erlanger, all of Ky.;  
Steve M. Bryan, Cincinnati, Ohio

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 244,052

[22] Filed: Sep. 13, 1988

[51] Int. Cl.<sup>5</sup> ..... G06F 15/20  
[52] U.S. Cl. .... 364/521  
[58] Field of Search ... 364/518, 521, 523, 200 MS File,  
364/900 MS File; 382/16, 25; 340/721, 723,  
798-800

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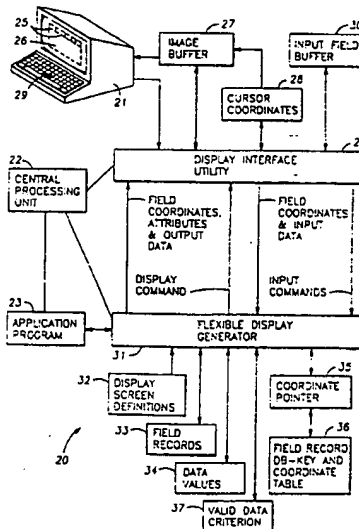
Primary Examiner—Heather R. Herndon

Attorney, Agent, or Firm—Michael J. Femal; Richard C. Auchterlonie

## [57] ABSTRACT

A data display, preferably having screens or windows, is built from data in a data base according to a hierarchy of display knowledge. Therefore, the data values themselves are separate from the knowledge or rules that specify how the data values are displayed to a user. In particular, the display knowledge is arranged in a hierarchy so that an individual item of display knowledge may be applicable to a wide range of data values representing the attributes of a number of different objects. In many cases, the range of data values or the attributes which the data values represent can be changed without any need to change the display knowledge. In other cases, only minor changes to the display knowledge are needed to properly display values for new or different data. These minor changes, for example, need only be made by changing the lowest level in the hierarchy of the display knowledge or associating items of display knowledge in the lowest level with different display knowledge in the higher levels. In a preferred embodiment, the highest level of the hierarchy of display knowledge defines individual display screens, and the lowest level defines fields of successive character locations on the display screens. The individual display screens are defined by a particular sequence of fields and the data values to be displayed or associated with the fields.

24 Claims, 9 Drawing Sheets



# United States Patent [19]

Watt et al.

[11] Patent Number: 5,072,356

[45] Date of Patent: Dec. 10, 1991

[54] LADDER DRUM SEQUENCE CONTROLLER

[75] Inventors: Kim J. Watt, Milwaukee; Charles C. Ksicinski, Whitefish Bay; Gary A. Romanowich, Wauwatosa; Richard L. Ryan, Waukesha, all of Wis.

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 504,057

[22] Filed: Apr. 2, 1990

## Related U.S. Application Data

[63] Continuation of Ser. No. 180,093, Apr. 11, 1988, abandoned.

[51] Int. Cl.<sup>5</sup> ..... G05B 11/01

[52] U.S. Cl. .... 364/140; 364/136

[58] Field of Search ..... 364/136, 140, 141, 146, 364/147, 900 MS File, 143

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Primary Examiner—Jerry Smith

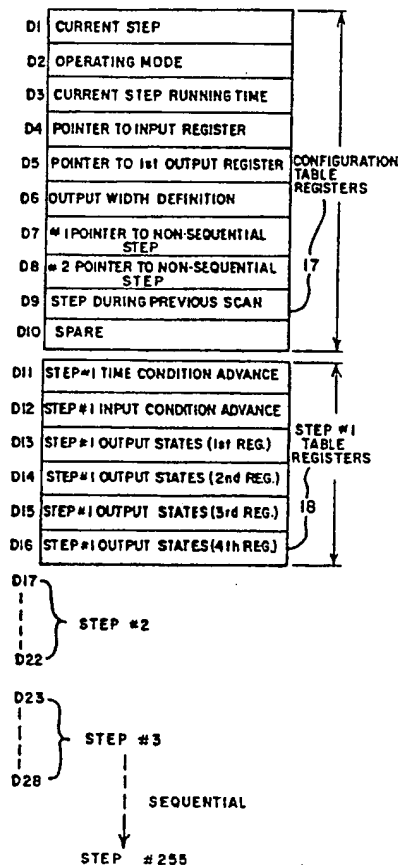
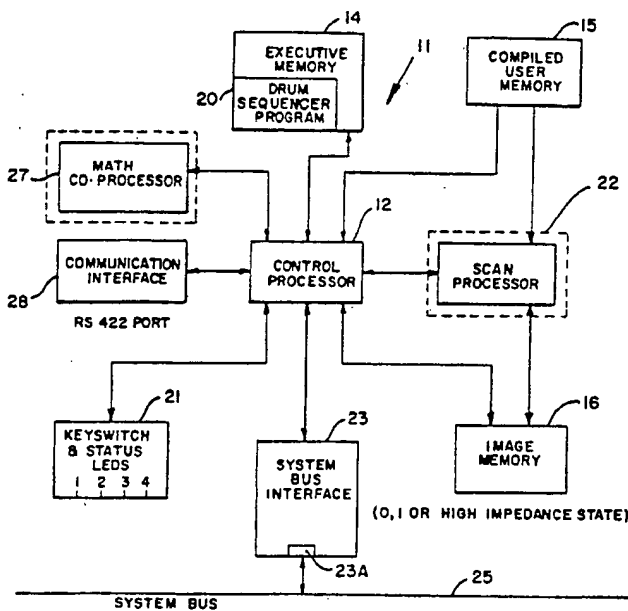
Assistant Examiner—Jim Trammell

Attorney, Agent, or Firm—Michael J. Femal; Thomas K. Stine

[57] ABSTRACT

A drum-type sequencer operable in a ladder logic program and capable of being selectively stepped in various modes; that is, in forward stepped sequence, non-sequentially, and backward.

6 Claims, 4 Drawing Sheets



- [54] USER INTERFACE WITH MULTIPLE WORKSPACES FOR SHARING DISPLAY SYSTEM OBJECTS
- [75] Inventors: D. Austin Henderson, Jr., Palo Alto; Stuart K. Card, Los Altos Hills; John T. Maxwell, III, Sunnyvale, all of Calif.
- [73] Assignee: Xerox Corporation, Stamford, Conn.
- [21] Appl. No.: 30,766
- [22] Filed: Mar. 25, 1987
- [51] Int. Cl.<sup>5</sup> ..... G06F 15/62
- [52] U.S. Cl. .... 395/159; 395/158
- [58] Field of Search ..... 364/518-522;  
340/724, 716; 382/44-46

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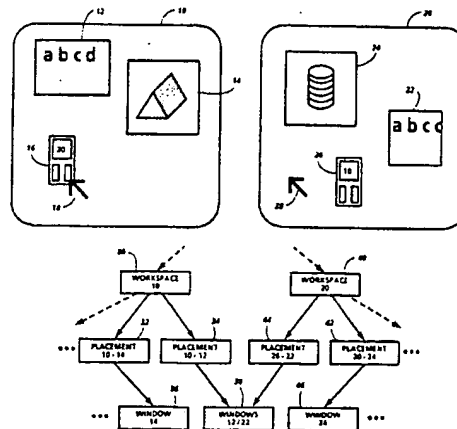
(List continued on next page.)

Primary Examiner—Heather R. Herndon  
Attorney, Agent, or Firm—James T. Beran

[57] ABSTRACT

Workspaces provided by an object-based user interface appear to share windows and other display objects. Each workspace's data structure includes, for each window in that workspace, a linking data structure called a placement which links to the display system object which provides that window, which may be a display system object in a preexisting window system. The placement also contains display characteristics of the window when displayed in that workspace, such as position and size. Therefore, a display system object can be linked to several workspaces by a placement in each of the workspaces' data structures, and the window it provides to each of those workspaces can have unique display characteristics, yet appear to the user to be the same window or versions of the same window. As a result, the workspaces appear to be sharing a window. Workspaces can also appear to share a window if each workspace's data structure includes data linking to another workspace with a placement to the shared window. The user can invoke a switch between workspaces by selecting a display object called a door, and a back door to the previous workspace is created automatically so that the user is not trapped in a workspace. A display system object providing a window to a workspace being left remains active so that when that workspace is reentered, the window will have the same contents as when it disappeared. Also, the placements of a workspace are updated so that when the workspace is reentered its windows are organized the same as when the user left that workspace. The user can enter an overview display which shows a representation of each workspace and the windows it contains so that the user can navigate to any workspace from the overview.

62 Claims, 19 Drawing Sheets







US005109487A

**United States Patent** [19]

Ohgomori et al.

[11] **Patent Number:** 5,109,487[45] **Date of Patent:** Apr. 28, 1992[54] **SYSTEM AND METHOD FOR DISTRIBUTED DATA PROCESSING UTILIZING DISTRIBUTED DISPLAY FORMAT**[75] **Inventors:** Seizi Ohgomori, Funabashi; Hiroshi Tsukino, Kawasaki; Ryoichi Nakazato, Ebina, all of Japan[73] **Assignees:** Hitachi, Ltd.; Hitachi Computer Consultant Ltd., both of Tokyo, Japan[21] **Appl. No.:** 260,745[22] **Filed:** Oct. 21, 1988[30] **Foreign Application Priority Data**

Oct. 21, 1987 [JP] Japan ..... 62-263826

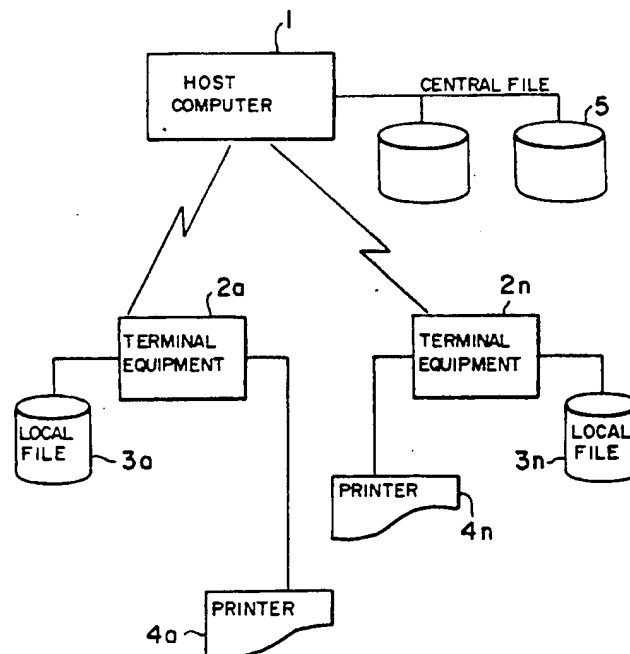
[51] **Int. Cl.:** ..... G06F 3/153[52] **U.S. Cl.:** ..... 395/200; 395/148; 364/931.43; 364/942.03; 364/956.1; 364/967.1; 364/947.7; 364/943.44; 364/975.1[58] **Field of Search** ..... 364/900, 200, 518, 403, 364/401, 406; 395/148[56] **References Cited****U.S. PATENT DOCUMENTS**

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*Primary Examiner*—Michael R. Fleming*Assistant Examiner*—Ayaz R. Sheikh*Attorney, Agent, or Firm*—Pennie & Edmonds[57] **ABSTRACT**

A data distribution processing system and a data distribution processing method in the system including a data processor having a memory capable of separately storing data display formats and corresponding data and a plurality of terminals each having a memory capable of storing data display formats. The data processor beforehand stores the data display formats and delivers the display formats to one of the terminals for storage in that terminal's memory. The data processor sends, in response to a request for data associated with the data display format from the terminal, data related to the data display format in the processor's memory to the terminal requesting the data. The terminal sends, in response to an entered specification of a data display format, a request for data associated with that data display format to the data processor, reads the data display format from its own memory together with the data sent from the data processor in response to the request. The terminal then displays a combined image. Also in the terminal, in response to the display, data is manually inputted and is then sent to the data processor so as to be stored in the processor's memory.

**17 Claims, 13 Drawing Sheets**



US005122948A

# United States Patent [19]

Zapolin

[11] Patent Number: 5,122,948

[45] Date of Patent: Jun. 16, 1992

## [54] REMOTE TERMINAL INDUSTRIAL CONTROL COMMUNICATION SYSTEM

[75] Inventor: Richard E. Zapolin, Lexington, Mass.

[73] Assignee: Allen-Bradley Company, Inc., Milwaukee, Wis.

[21] Appl. No.: 546,165

[22] Filed: Jun. 28, 1990

[51] Int. Cl.<sup>5</sup> ..... G06F 13/14

[52] U.S. Cl. .... 364/131; 364/138; 340/825.07

[58] Field of Search ..... 364/131, 133, 138; 340/825.06, 825.07, 825.44, 870.11, 870.07; 370/60, 92, 94.1

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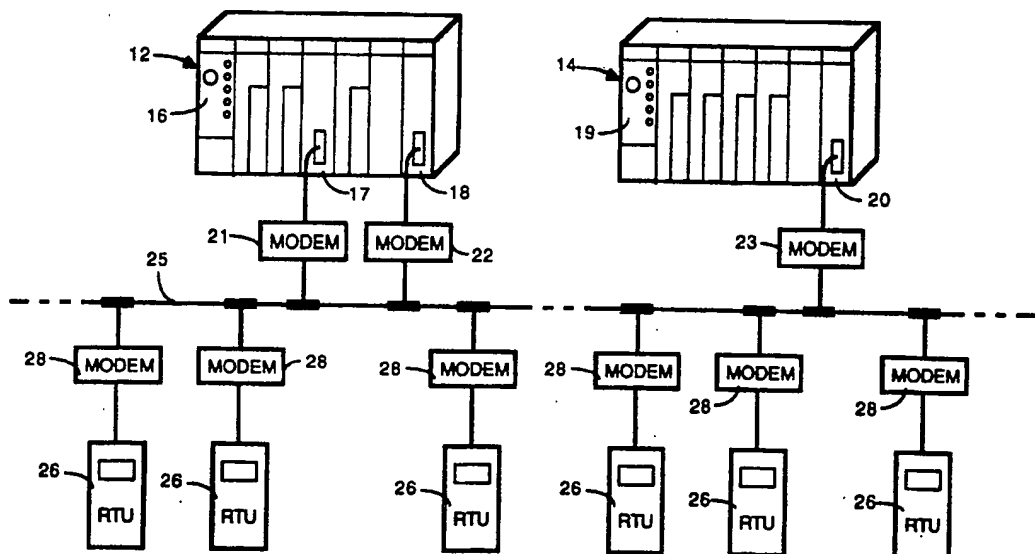
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Primary Examiner—Jerry Smith  
Assistant Examiner—Paul Gordon  
Attorney, Agent, or Firm—Quarles & Brady

## [57] ABSTRACT

An industrial control system has a central processing unit and a plurality of remote terminal units coupled to a communication network. Data is exchanged among the network devices in the form of messages which contain a source address, which designates the network address of the device that sent the message, and a destination address. Each of the remote terminal units stores a first network address assigned to the unit, and second network address corresponding to the network address of the originator of messages to which the remote terminal unit is to respond. The remote terminal unit processes only those messages in which both the destination address matches the first network address and the source address in the message matches the second network address. Thus multiple devices can be assigned the same first network address as long as each such device responds to a different source address. This enables more devices to be coupled to the network than the maximum number of allowable network addresses. Similarly multiple central processing units can be coupled to the network with access to a given remote terminal unit being restricted by the second address to messages originating from only one of the central processing units.

12 Claims, 3 Drawing Sheets



**United States Patent** [19]  
**Sackmann et al.**

US005131092A  
[11] Patent Number: **5,131,092**  
[45] Date of Patent: **Jul. 14, 1992**

[54] COMMUNICATION SYSTEM ENABLING PROGRAMMABLE LOGIC CONTROLLERS ACCESS TO HOST COMPUTER TASKS AND HOST COMPUTER ACCESS TO PROGRAMMABLE LOGIC CONTROLLERS WITHOUT POLLING

[75] Inventors: David J. Sackmann, Milwaukee; Brian T. Hill, Mequon; Joseph T. Bronikowski, Milwaukee; Mark S. Weber, Germantown, all of Wis.

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 402,482

[22] Filed: Sep. 1, 1989

[51] Int. Cl.<sup>5</sup> ..... G06F 13/00

[52] U.S. Cl. .... 395/800; 364/147; 364/940.9; 364/931.4; 364/926.9; 364/965.9; 364/DIG. 1; 364/DIG. 2

[58] Field of Search ... 364/200 MS File, 900 MS File, 364/132, 136, 147

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Primary Examiner—Thomas C. Lee

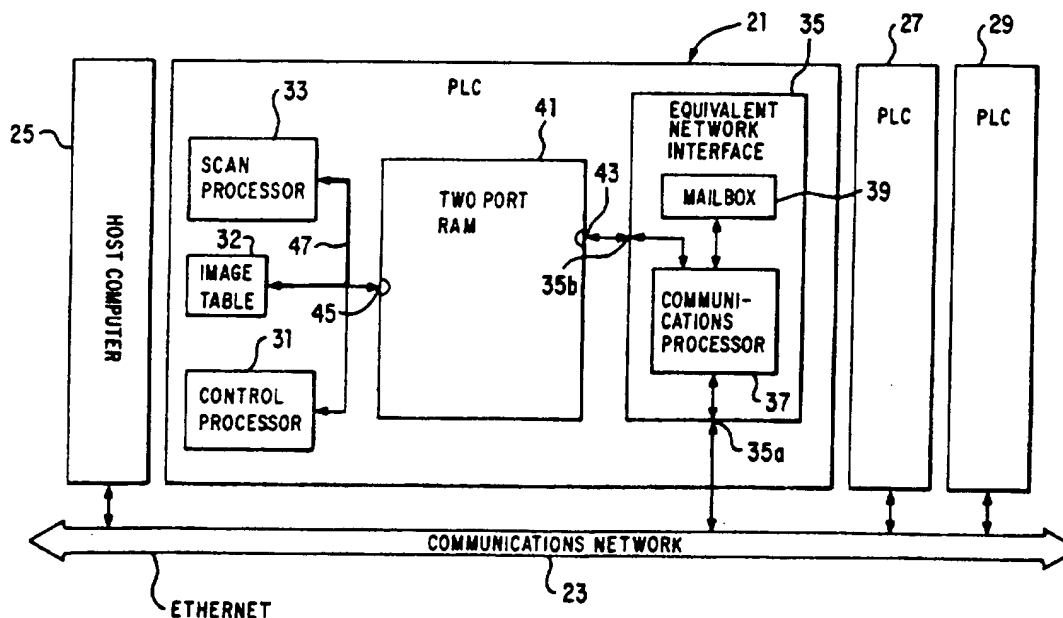
Assistant Examiner—William M. Treat

Attorney, Agent, or Firm—Michael J. Femal; Thomas K. Stine

[57] ABSTRACT

A high speed control system allows for transferring messages between a programmable logic controller and a host computer over an Ethernet communications network. The host computer includes prioritized alarm queues for receiving prioritized alarms from the programmable logic controller. Alarms fall into either a local or a global category, and each category supports three types of alarms: warnings, alerts or faults. The system is responsive to the routing address for transferring the messages between the programmable logic controller and the host computer. The host computer can immediately obtain messages from a programmable logic controller without interruption of the execution of its ladder program. The host computer can also receive unsolicited messages from the programmable logic controller. The programmable logic controller can communicate with tasks within the host computer as though those tasks were other programmable logic controllers.

9 Claims, 2 Drawing Sheets





US005134574A

**United States Patent** [19]

Beaverstock et al.

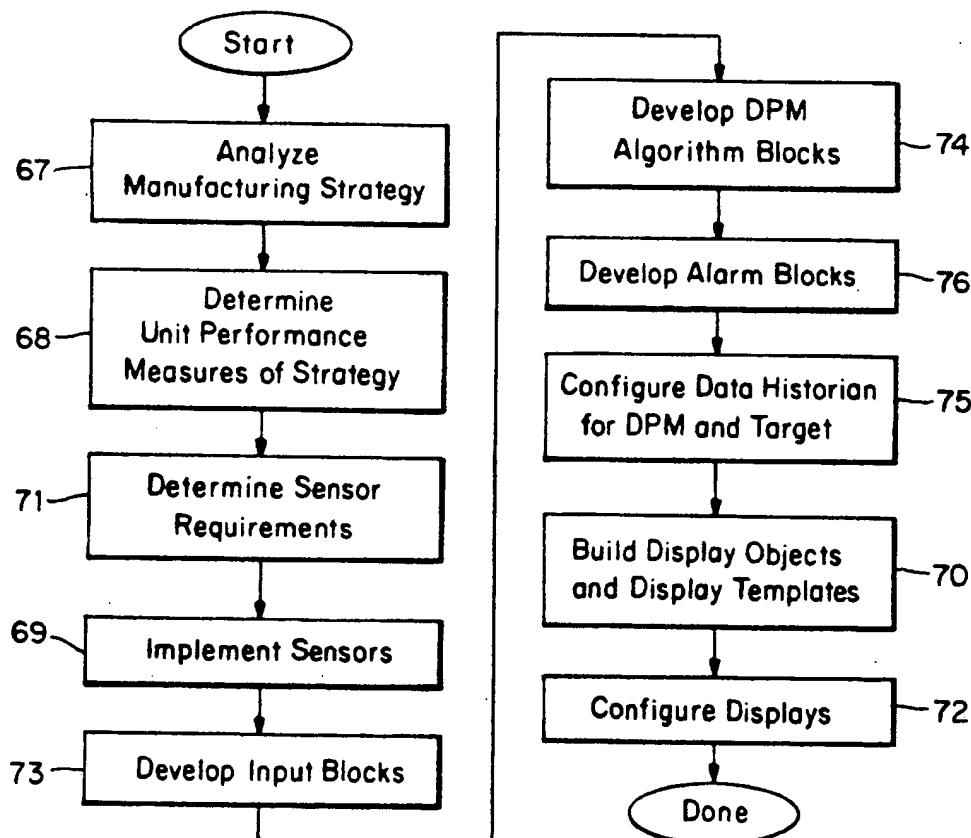
[11] **Patent Number:** **5,134,574**[45] **Date of Patent:** **Jul. 28, 1992**[54] **PERFORMANCE CONTROL APPARATUS  
AND METHOD IN A PROCESSING PLANT**[75] **Inventors:** **Malcolm C. Beaverstock**, Foxboro;  
**Peter G. Martin**, Carver, both of  
Mass.[73] **Assignee:** **The Foxboro Company**, Foxboro,  
Mass.[21] **Appl. No.:** **485,698**[22] **Filed:** **Feb. 27, 1990**[51] **Int. Cl.:** ..... **G06F 15/20**[52] **U.S. Cl.:** ..... **364/551.01; 364/131;**  
364/552[58] **Field of Search** ..... **364/131, 551.01, 551.02,**  
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*Primary Examiner*—Parshotam S. Lall*Assistant Examiner*—Edward R. Cosimano*Attorney, Agent, or Firm*—Hamilton, Brook, Smith &  
Reynolds[57] **ABSTRACT**

Processing plant control apparatus provides real-time indications of performance of plant operations with respect to current state of process means. The real-time indications enable operations personnel to timely adjust process means to improve current performance of plant operations. Sensors coupled to the process means provide data input to the computer means of control apparatus. The computer means performs programmed computations on the input data to provide quantitative information of current performance of plant operations. The control apparatus provides the computer information in a graphical form displayed on video displays. Video displays of the computed information over time are also provided. The control apparatus also stores the computed information in a relational database which enables access to the information for other applications.

**18 Claims, 6 Drawing Sheets**



US005151978A

**United States Patent** [19]

Bronikowski et al.

[11] **Patent Number:** 5,151,978[45] **Date of Patent:** Sep. 29, 1992

[54] LAN INTERFACE WHICH PERMITS A HOST COMPUTER TO OBTAIN DATA WITHOUT INTERRUPTING A LADDER PROGRAM EXECUTING IN THE INTERFACE

[75] Inventors: Joseph T. Bronikowski, Milwaukee; Brian T. Hill, Mequon; David J. Sackmann, Milwaukee; Mark S. Weber, Germantown, all of Wis.

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 497,451

[22] Filed: Mar. 22, 1990

[51] Int. Cl. G06F 13/12

[52] U.S. Cl. 395/200; 364/DIG. 1; 364/927.94; 364/239.51

[58] Field of Search 364/200, 900, DIG. 1, 364/DIG. 2; 395/200, 250, 275, 325, 800

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Primary Examiner—Thomas C. Lee

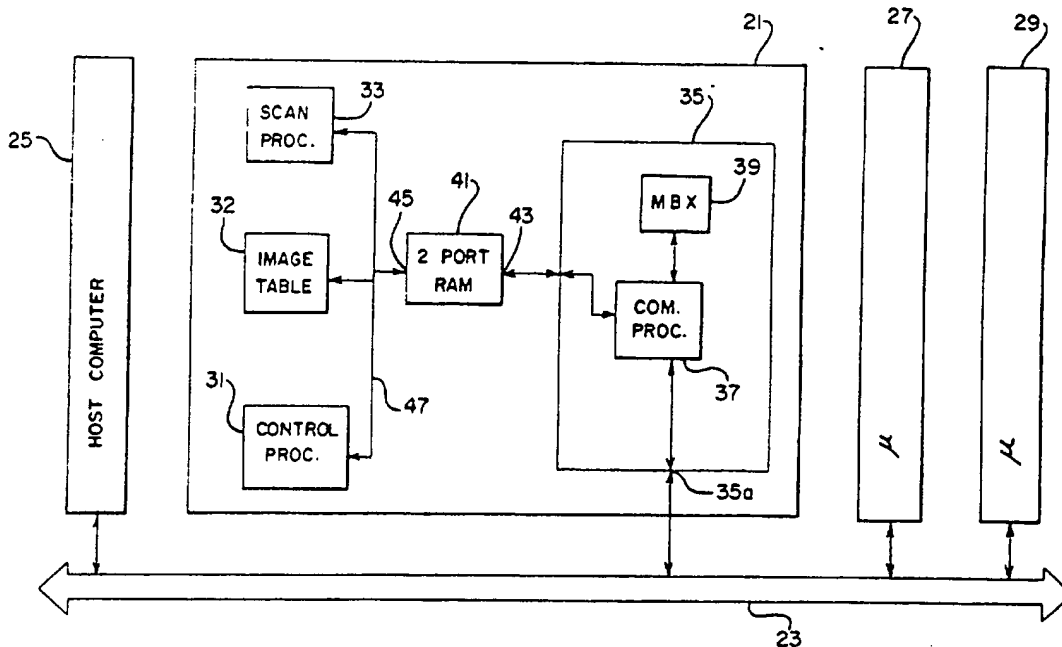
Assistant Examiner—Robert B. Harrell

Attorney, Agent, or Firm—Michael J. Femal; Thomas K. Stine; Richard J. Graefe

[57] **ABSTRACT**

A control system allows for transferring messages between a programmable logic controller and a host computer over a serial data communications network. The programmable logic controller executes a ladder program and has an integral network interface module for permitting direct communicative coupling to the communications network. Messages can be received and sent by the programmable logic controller without interruption of the execution of the ladder program. The programmable logic controller can receive unsolicited messages from the host computer.

10 Claims, 4 Drawing Sheets



# United States Patent [19]

Bowman et al.

US005151896A

[11] Patent Number: 5,151,896

[45] Date of Patent: Sep. 29, 1992

## [54] MODULAR DIGITAL TELEPHONE SYSTEM WITH FULLY DISTRIBUTED LOCAL SWITCHING AND CONTROL

[76] Inventors: Donald J. Bowman, 135 Grayson Ct., Colorado Springs, Colo. 80906; Jerry D. Crane, 29335 Nole Haze, Boerne, Tex. 78006; Scott G. Edwards; Kathryn M. Edwards, both of 17 Edith La., Wilton, Conn. 06895; Sven R. Englund, 9 Fairly Dr., New Canaan, Conn. 06840

[21] Appl. No.: 586,440

[22] Filed: Sep. 21, 1990

[51] Int. Cl.<sup>5</sup> ..... H04L 12/46; H04L 12/66

[52] U.S. Cl. .... 370/85.13; 370/67

[58] Field of Search ..... 370/85.1, 85.11, 85.14, 370/85.13, 66, 67, 58.1, 58.2, 58.3

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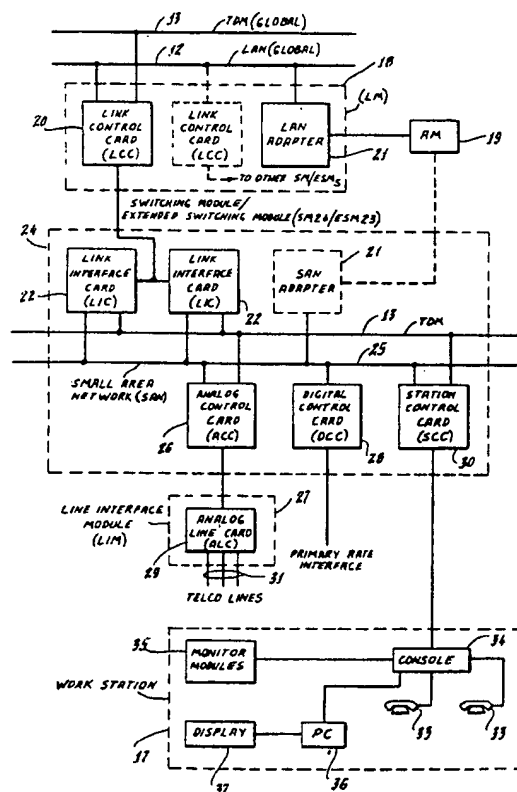
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Primary Examiner—Douglas W. Olms  
Assistant Examiner—Wellington Chin  
Attorney, Agent, or Firm—Parmelee, Bollinger & Bramblett

## [57] ABSTRACT

A distributed digital telephone system is provided wherein a plurality of telephone consoles have instant access to a plurality of telephone lines wherein in all of the connections within such a system are non-blocking. The system architecture is that of a reverse ratio PBX in which the number of lines exceed the number of consoles and each handset has a reserved time slot on time division multiplex (TDM) highways for internal node or group connections. Accordingly, each handset is guaranteed access to idle lines within any given switching node. The distributed architecture is distinguished from central processing where all call processing is directed through a centralized point. In this decentralized system, all signal conditioning, protection, sensing and control are provided by the resource interface with the TDM highways. Resource data reporting is continually provided to all the resources connected to the system that require it. Redundancy of critical resources is provided in such a manner that only the portion of the system where a fault occurs is disabled while the remainder of the system continues to operate.

18 Claims, 8 Drawing Sheets





US005157595A

# United States Patent [19]

Lovrenich

[11] Patent Number: 5,157,595  
[45] Date of Patent: \* Oct. 20, 1992

## [54] DISTRIBUTED LOGIC CONTROL SYSTEM AND METHOD

[75] Inventor: Rodger T. Lovrenich, Santa Teresa, N. Mex.

[73] Assignee: El Paso Technologies, Company, El Paso, Tex.

[\*] Notice: The portion of the term of this patent subsequent to Aug. 15, 2006 has been disclaimed.

[21] Appl. No.: 667,249

[22] Filed: Mar. 8, 1991

### Related U.S. Application Data

[63] Continuation of Ser. No. 463,868, Jan. 5, 1990, abandoned, which is a continuation of Ser. No. 340,435, Apr. 19, 1989, abandoned, which is a continuation of Ser. No. 38,018, Apr. 14, 1987, Pat. No. 4,858,102, which is a continuation-in-part of Ser. No. 757,279, Jul. 19, 1985, abandoned.

[51] Int. Cl.<sup>3</sup> ..... G06F 15/46; G05B 11/01

[52] U.S. Cl. .... 364/136; 364/141; 364/183; 364/474.11; 364/474.19

[58] Field of Search ..... 364/136, 140, 141, 147, 364/183, 184, 474.19, 474.2, 474.11, 900 MS File; 371/29.1, 47.1, 48

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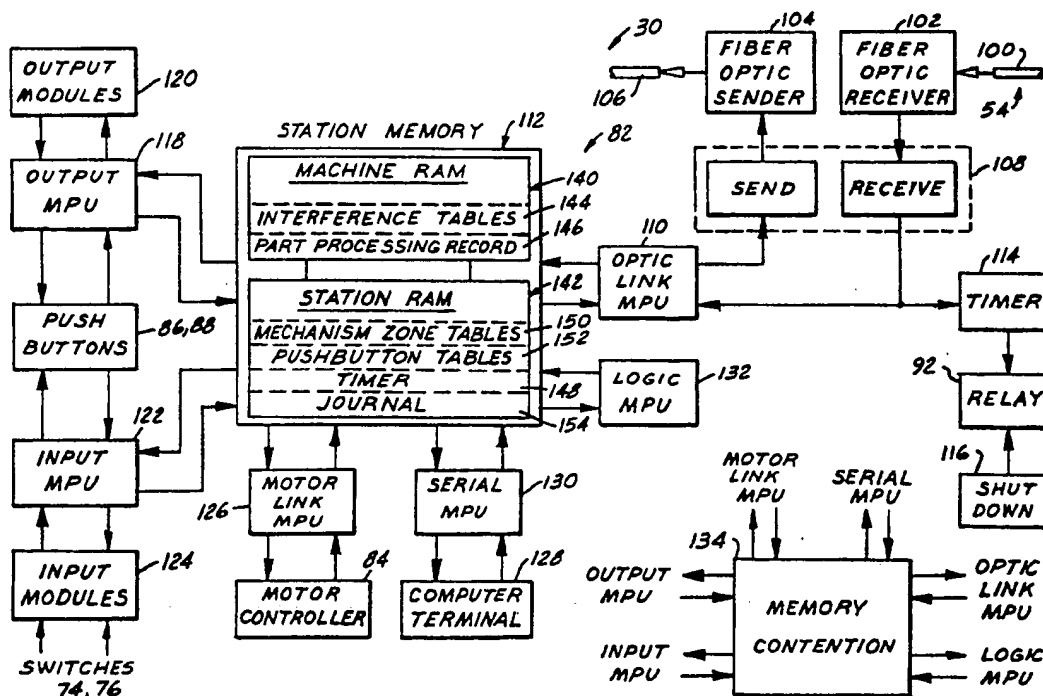
(List continued on next page.)

Primary Examiner—Jerry Smith  
Assistant Examiner—Jim Trammell  
Attorney, Agent, or Firm—Donald J. Lisa

### [57] ABSTRACT

A system and method for controlling operation of a plurality of elements in an automated process, such as a production process, and indicating error conditions as they occur. Each unique set of input and output conditions of the various system elements defines a unique logic state or zone. Thus, there are defined a multiplicity of valid system logic states or zones, each having a unique input/output image. A predetermined sequence of zones, productive zones representing designed machine operations, is stored in a zone table. All zones not explicitly defined in the zone table are automatically treated as error zones. A zone engine automatically cycles to observe any change in input/output image. Any change in inputs from the various system elements automatically transfer action to the unique zone associated with such inputs, resulting in corresponding changes in control outputs to the system elements and/or display an error message as appropriate.

40 Claims, 11 Drawing Sheets



**United States Patent** [19]  
**Sackmann et al.**



US005159673A

[11] **Patent Number:** **5,159,673**

[45] **Date of Patent:** **Oct. 27, 1992**

[54] **APPARATUS FOR NETWORKING  
PROGRAMMABLE LOGIC CONTROLLERS  
TO HOST COMPUTERS**

[75] **Inventors:** **David J. Sackmann**, Milwaukee;  
**Brian T. Hill**, Mequon; **Joseph T.  
Bronikowski**, Milwaukee; **Mark S.  
Weber**, Germantown, all of Wis.

[73] **Assignee:** **Square D Company**, Palatine, Ill.

[21] **Appl. No.:** **850,234**

[22] **Filed:** **Mar. 11, 1992**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 497,465, Mar. 22, 1990, abandoned.

[51] **Int. Cl.:** ..... **G06F 15/16**

[52] **U.S. Cl.:** ..... **395/325; 364/284.4;  
364/DIG. 1**

[58] **Field of Search** ..... **364/DIG. 1, DIG. 2;  
370/94.1, 60, 92, 79; 395/325**

[56]

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**Primary Examiner**—David Y Eng

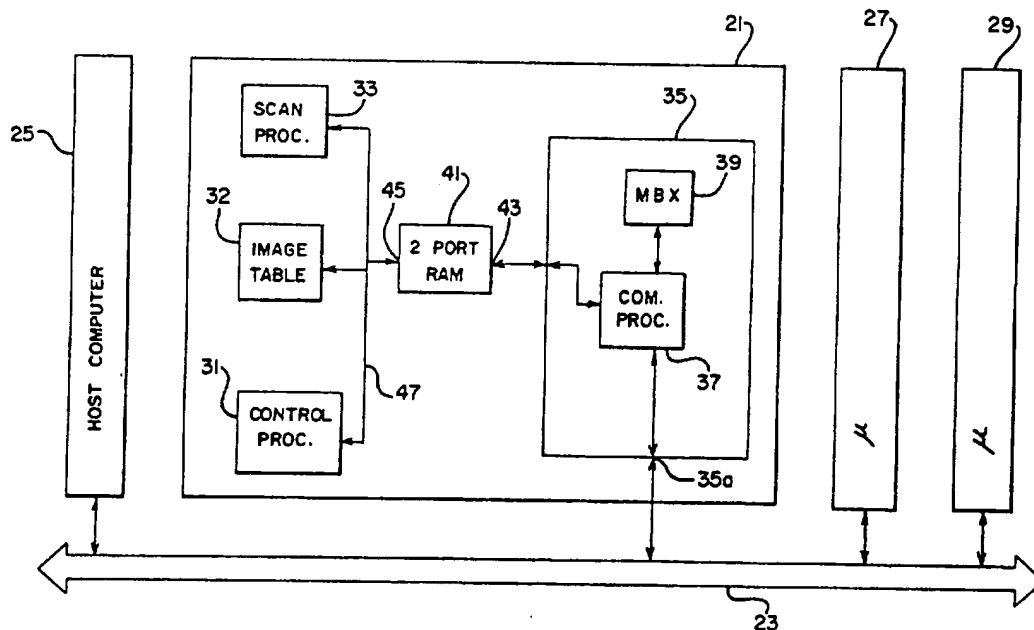
**Attorney, Agent, or Firm**—Michael J. Femal; Thomas K. Stine; Richard J. Graefe

[57]

**ABSTRACT**

A control system allows for transferring messages between a programmable logic controller and a host computer over an Ethernet communications network. The messages include a routing address specifying an originating drop number, a destination drop number, and a routing drop number. The system is responsive to the routing address for transferring the messages between the programmable logic controller and the host computer. The host computer can immediately obtain messages from a programmable logic controller without interruption of the execution of its ladder program. The host computer can also receive unsolicited messages from the programmable logic controller.

**5 Claims, 4 Drawing Sheets**





**United States Patent** [19]  
**Taguchi et al.**

US005161211A

[11] **Patent Number:** **5,161,211**  
[45] **Date of Patent:** **Nov. 3, 1992**

- [54] **METHOD AND SYSTEM OF SPECIFICATION PROCESSING**  
[75] **Inventors:** Kouichi Taguchi, Ashigarakami; Shinichi Yamada, Kawasaki, both of Japan  
[73] **Assignee:** Hitachi, Ltd., Tokyo, Japan  
[21] **Appl. No.:** 422,039  
[22] **Filed:** Oct. 16, 1989  
[30] **Foreign Application Priority Data**

Oct. 19, 1988 [JP] Japan ..... 63-261495

- [51] **Int. Cl.:** G06F 15/18; G06F 15/46  
[52] **U.S. Cl.:** 395/10; 364/138; 364/DIG. 1  
[58] **Field of Search:** 395/10; 364/138, 200

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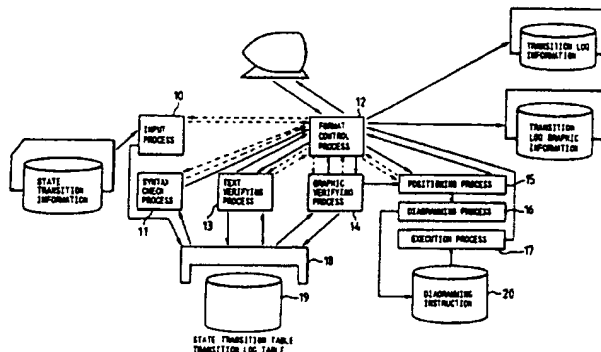
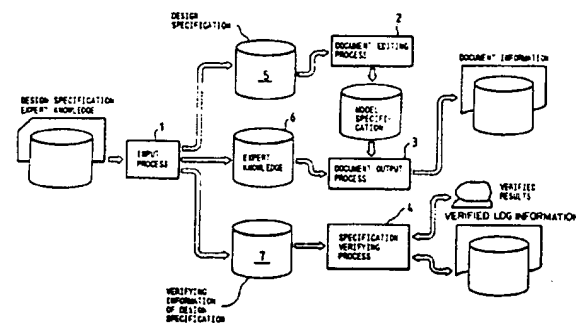
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63-101933	6/1988	Japan

**Primary Examiner**—Michael R. Fleming  
**Assistant Examiner**—George Davis  
**Attorney, Agent, or Firm**—Fay, Sharpe, Beall, Fagan, Minnich & McKee

[57] **ABSTRACT**

Disclosed herein are a method and a system of specification processing whereby are input the design specifications of a system under development, the expert knowledge of the system addressing these specifications, and the expert knowledge of a particular field to which the system belongs. The design specifications are transformed into information in list image having feasibility and containing state transitions and transition conditions. The information in list image is then edited as model specifications formed by the basic commands for outputting graphical image information. Document information is output in accordance with the model specifications (instruction words) and the expert knowledge. When output, the document information has high levels of both formality and understandability. The transformed information in list image can be verified in text image or graphical image in accordance with the transition conditions.

**3 Claims, 32 Drawing Sheets**



**United States Patent** [19]  
**Barker**



US005165030A

[11] **Patent Number:** **5,165,030**

[45] **Date of Patent:** **Nov. 17, 1992**

[54] **METHOD AND SYSTEM FOR DYNAMIC CREATION OF DATA STREAM BASED UPON SYSTEM PARAMETERS AND OPERATOR SELECTIONS**

[75] **Inventor:** **Barbara A. Barker, Round Rock, Tex.**

[73] **Assignee:** **International Business Machines Corporation, Armonk, N.Y.**

[21] **Appl. No.:** **321,931**

[22] **Filed:** **Mar. 10, 1989**

[51] **Int. Cl.<sup>5</sup>** ..... **G06F 3/14; G06F 15/403; G06F 9/06; G06F 15/40**

[52] **U.S. Cl.** ..... **395/500; 364/237.2; 364/234.3; 364/234.4; 364/231; 364/231.31; 364/242.94; 364/242.95; 364/242.96; 364/242.5; 364/280; 364/280.7; 364/281.7; 364/281.6; 364/283.3; 364/284.4; 364/286; 364/286.1; 364/286.2; 364/286.3; 364/419; 364/DIG. 1; 364/DIG. 2**

[58] **Field of Search** ..... **340/706; 395/800, 500, 395/600, 325, 375, 147, 153; 364/419, 200 MS File, 900 MS File**

[56] **References Cited**

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*Primary Examiner*—Thomas C. Lee

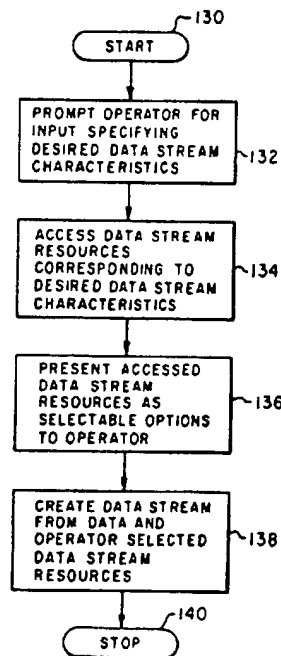
*Assistant Examiner*—Daniel H. Pan

*Attorney, Agent, or Firm*—Andrew J. Dillon

[57] **ABSTRACT**

A method for the dynamic creation of a data stream of continuous data elements for transmission by a data processing system. One or more data stream libraries are created within external or "in-line" storage facilities for utilization by the data stream build process and a plurality of data resources are stored therein. Data stream resources may include: data stream templates; environments; page structures; formatting descriptions; and, object data. Object data may include: text; image; graphics; font specifications; color tables; and, code page specifications. The data stream build process then prompts the operator for inputs which specify desired data stream characteristics. A plurality of options are then presented to the operator based upon the operator's inputs and selected data processing system parameters which are utilized in a heuristic manner as determined by system parameters. A data stream is then dynamically created from selected resources stored within the data stream libraries or created in response to selections by the operator from the plurality of options presented by the dynamic build process.

**10 Claims, 6 Drawing Sheets**





US005179700A

**United States Patent** [19]  
**Aihara et al.**

[11] **Patent Number:** **5,179,700**  
 [45] **Date of Patent:** **Jan. 12, 1993**

[54] **USER INTERFACE CUSTOMIZATION  
 APPARATUS**

[75] **Inventors:** Toru Aihara, Yokohama; Masanobu Ogata, Tokyo; Takashi Kurosawa, Tokyo; Yeong-Chang L. Lien, Tokyo, all of Japan

[73] **Assignee:** International Business Machines Corporation, Armonk, N.Y.

[21] **Appl. No.:** 555,207

[22] **Filed:** Jul. 18, 1990

[30] **Foreign Application Priority Data**

Jul. 19, 1989 [JP] Japan ..... 64-184880

[51] **Int. Cl.:** ..... G06F 13/00

[52] **U.S. Cl.:** ..... 395/650; 395/157;  
 364/DIG. 1; 364/237.3; 364/239.3; 364/246.3;  
 364/260.4

[58] **Field of Search** ..... 364/200, 900, DIG. 1;  
 395/155, 157, 600, 650

[56] **References Cited**

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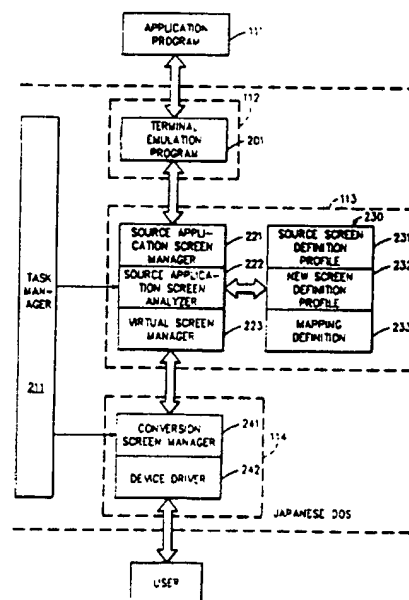
*Primary Examiner*—Thomas M. Heckler

*Attorney, Agent, or Firm*—Mark S. Walker

[57] **ABSTRACT**

An interactive computer system for converting user interface presentations from a first application specified format to a second user specified format. The system accepts application program output designed to be displayed on a target type of computer system terminal and, converts the display to a user specified form prior to display. Through conversion apparatus and process the user may specify a customized format for presentation of the data from the application program to take advantage of the capabilities of a particular display device employed by that user. The system analyses the application program output, and converts the output to a form required by the customized interface and display the resulting output on the user display device. The system is able to accept data input and commands from the user display device, convert them into a form required by the application program and transmit that input or command to the application program. The application allows adaptation from one format to another and from one language to another. All changes are accomplished without changing the base application program.

**28 Claims, 12 Drawing Sheets**





US005225974A

**United States Patent** [19]

Mathews et al.

[11] **Patent Number:** **5,225,974**[45] **Date of Patent:** **Jul. 6, 1993**[54] **PROGRAMMABLE CONTROLLER  
PROCESSOR WITH AN INTELLIGENT  
FUNCTIONAL MODULE INTERFACE**[75] Inventors: Kathleen B. Mathews, Chesterland;  
Wayne C. Van Sickle, South Euclid;  
Donald A. Westman, Mentor; Ronald  
E. Schultz, Solon, all of Ohio[73] Assignee: Allen-Bradley Company, Inc.,  
Milwaukee, Wis.

[21] Appl. No.: 605,891

[22] Filed: Oct. 30, 1990

[51] Int. Cl.<sup>5</sup> ..... G06F 9/06; G06F 13/10[52] U.S. Cl. .... 364/140; 364/136;  
364/DIG. 2; 364/926.9; 364/949; 364/947.4;  
395/275; 395/425[58] Field of Search ..... 364/140-147,  
364/136, DIG. 1 MS File, DIG. 2 MS File;  
395/275, 325, 425[56] **References Cited****U.S. PATENT DOCUMENTS**

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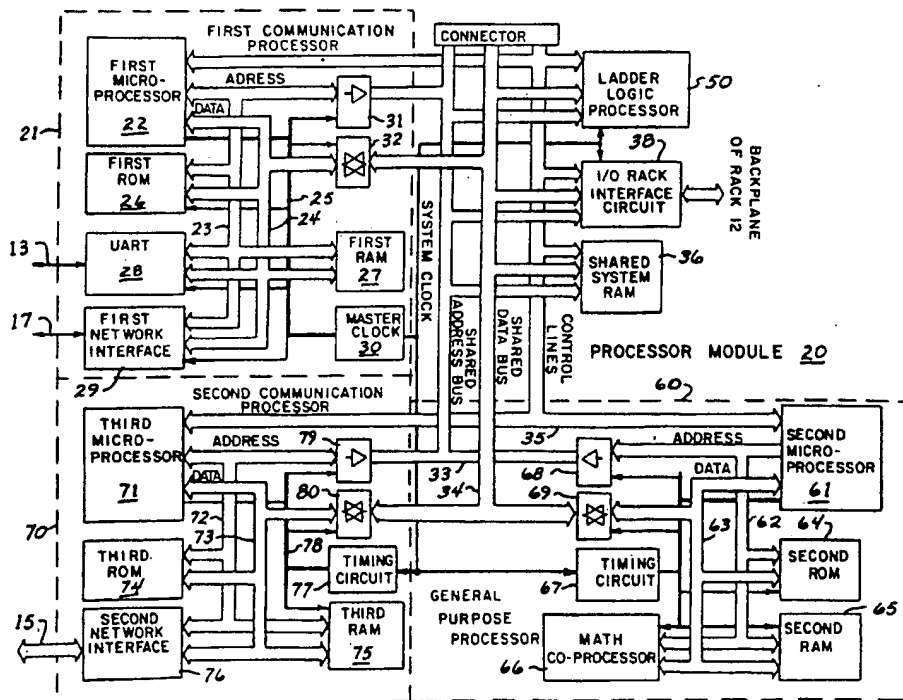
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Primary Examiner—Joseph Ruggiero  
Attorney, Agent, or Firm—Quarles & Brady[57] **ABSTRACT**

A programmable controller has a rack that houses and electrically connects a number of I/O modules and a processor module. The processor module includes a external communication network interface, a system memory, a processor section which executes a user-defined control program and a I/O interface that handles the exchange of data with the other modules. The I/O interface has circuitry for pre-processing data from defined input modules, thereby relieving the processing section of certain tasks. The shared memory contains information defining the input module from which to obtain data for pre-processing and the bits of that data to be examined for specified logic level transitions. The stored information also designates the frequency at which the data is to be read from the defined input module and how many occurrences of the specified logic level transitions must take place before the I/O interface signals the processor section that the pre-processing is complete.

**22 Claims, 6 Drawing Sheets**



US005245704A

**United States Patent** [19]

Weber et al.

[11] **Patent Number:** 5,245,704[45] **Date of Patent:** Sep. 14, 1993[54] **SYSTEM FOR SHARING DATA BETWEEN MICROPROCESSOR BASED DEVICES**

[75] Inventors: Mark S. Weber, Germantown;  
Joseph T. Bronikowski, Milwaukee;  
Brian T. Hill, Mequon; David J.  
Sackmann, Milwaukee, all of Wis.

[73] Assignee: Square D Company, Palatine, Ill.

[21] Appl. No.: 497,461

[22] Filed: Mar. 22, 1990

[51] Int. Cl.<sup>3</sup> ..... G06F 15/46

[52] U.S. Cl. .... 395/200; 364/136;  
364/DIG. 2; 364/926.9; 364/940.9; 364/949;  
364/940.62

[58] Field of Search ..... 395/200; 364/136

[56] **References Cited****U.S. PATENT DOCUMENTS**

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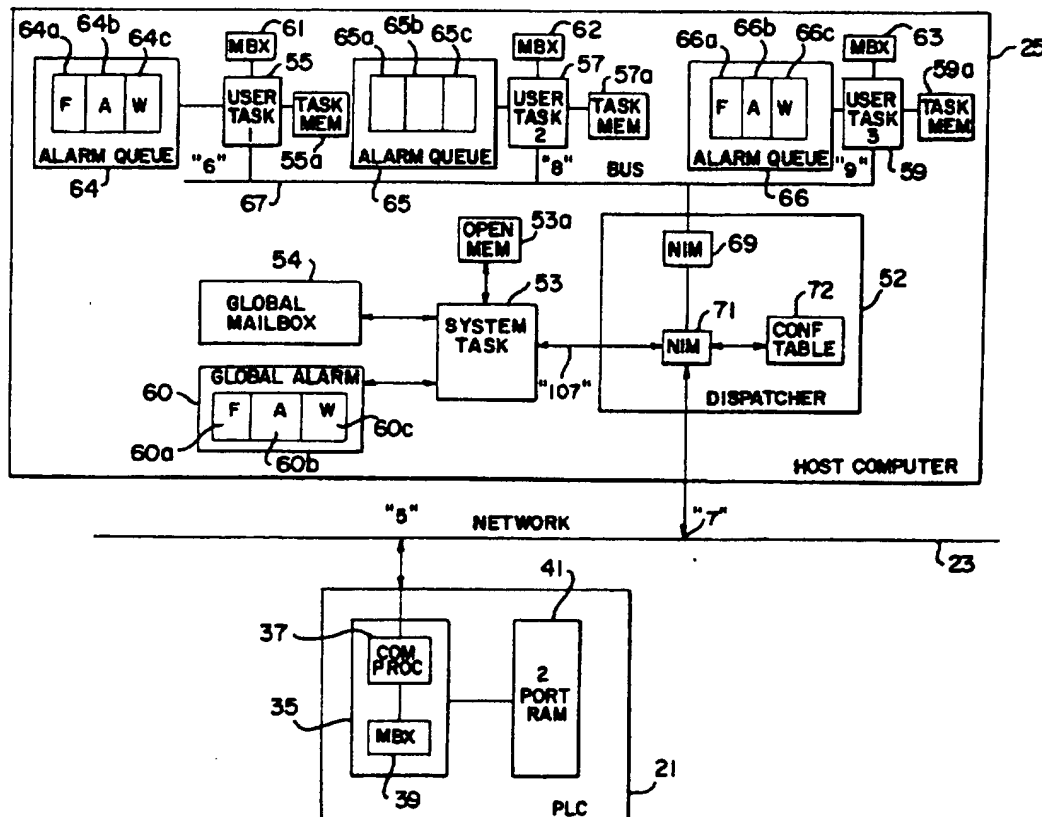
*Primary Examiner*—Thomas M. Heckler

*Attorney, Agent, or Firm*—Larry I. Golden; Michael J. Femal; Richard J. Graefe

[57] **ABSTRACT**

A system allows for transferring messages between microprocessor based devices, such as programmable logic controllers (PLC), and a host computer over an Ethernet communications network. At the host computer level, these messages can be directed globally or locally. The host computer can immediately obtain messages from a programmable logic controller without interruption of the execution of the PLC's ladder program. The host computer can also receive unsolicited messages from the PLC.

9 Claims, 4 Drawing Sheets





US005251302A

**United States Patent** [19]

Weigl et al.

[11] **Patent Number:** 5,251,302[45] **Date of Patent:** Oct. 5, 1993

[54] **NETWORK INTERFACE BOARD HAVING MEMORY MAPPED MAILBOX REGISTERS INCLUDING ALARM REGISTERS FOR STORING PRIORITIZED ALARM MESSAGES FROM PROGRAMMABLE LOGIC CONTROLLERS**

[75] **Inventors:** Edward H. Weigl, Deerfield, Ill.;  
David J. Sackmann, Milwaukee;  
Steven J. Gans, Mequon, all of Wis.

[73] **Assignee:** Square D Company, Palatine, Ill.

[21] **Appl. No.:** 815,565

[22] **Filed:** Dec. 26, 1991

**Related U.S. Application Data**

[63] Continuation of Ser. No. 179,756, Apr. 11, 1988, abandoned.

[51] **Int. Cl.:** G05B 19/00; G06F 11/30

[52] **U.S. Cl.:** 395/250; 364/131;  
364/DIG. 2; 364/921; 364/926.2; 364/927.94;  
364/927.95; 364/927.96; 364/929.5;  
364/931.44; 364/940.2; 364/940.62; 364/940.9;  
364/942.4; 364/957.6; 364/965.4; 364/943.9;  
340/825.16; 340/825.36; 371/29.1

[58] **Field of Search** 364/DIG. 1, DIG. 2,  
364/131, 134, 146, 200, 900; 395/250;  
340/825.05, 825.16, 825.36; 371/29.1; 370/85

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**Primary Examiner**—Thomas C. Lee

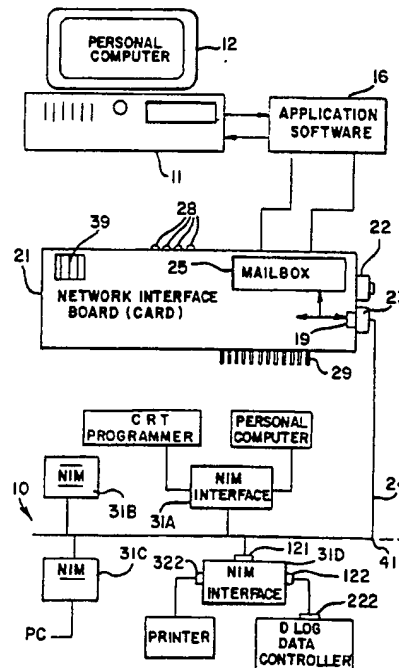
**Assistant Examiner**—Matthew C. Fagan

**Attorney, Agent, or Firm**—Michael J. Femal; Richard J. Graefe; Thomas K. Stine

**[57]****ABSTRACT**

A network interface board provides a communication link between a personal computer and a network bus connecting a plurality of programmable logic controllers. The network interface board mounts in an expansion slot of the personal computer. The programmable logic controllers control the operation of various machines. The network interface board includes mailbox registers for storing messages from the network, including three different queues of alarm messages which the personal computer can access in any order. These messages could be in the form of program steps, allowing the personal computer to directly program a programmable logic controller over the communication network.

10 Claims, 3 Drawing Sheets





[54] **REMOTE CONTROL OF A LOCAL PROCESSOR CONSOLE**

[75] **Inventors:** Mary K. Dangler, Endicott; Samuel L. Wentz, Endwell, both of N.Y.

[73] **Assignee:** International Business Machines Corporation, Armonk, N.Y.

[21] **Appl. No.:** 575,746

[22] **Filed:** Aug. 31, 1990

[51] **Int. Cl.<sup>5</sup>** ..... G06F 15/401

[52] **U.S. Cl.** ..... 395/149; 395/153; 345/1

[58] **Field of Search** ..... 395/148, 149, 153; 340/717, 711

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**Primary Examiner**—Gary V. Harkcom

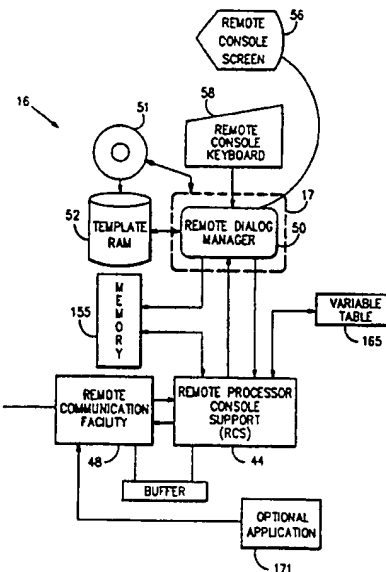
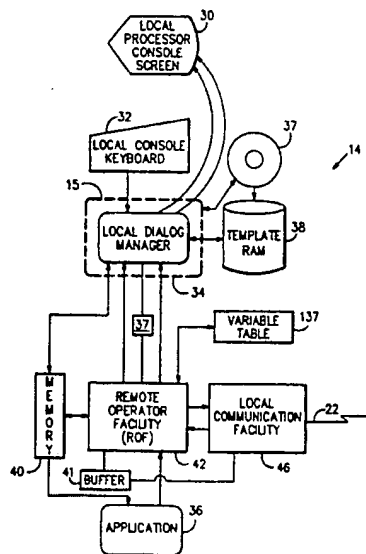
**Assistant Examiner**—Joseph H. Feild

**Attorney, Agent, or Firm**—Arthur J. Samodovitz

[57] **ABSTRACT**

A first processor console includes a first display screen and a first storage device for storing panel templates containing fixed panel information for display on the first display screen. A second processor console includes a second display screen and a second storage device for storing panel templates containing fixed panel information for display on the second display screen. The first processor console transmits to the second processor console an identification of a panel template for display on the second display screen. The second processor console receives the panel template identification, determines if the panel template identification identifies a panel stored in the second storage means and displays the panel on the second display screen if the identification identifies a panel stored in the second storage device, and requests transmission of the identified panel template if the second storage device does not contain the identified panel template. The first processor console also transmits variable information to the second processor console for merger with the identified panel template. The first and second processor consoles utilize standard operating systems to participate in the remote operations.

13 Claims, 14 Drawing Sheets





US005297257A

**United States Patent** [19][11] **Patent Number:** **5,297,257****Struger et al.**[45] **Date of Patent:** **Mar. 22, 1994**

[54] **DISTRIBUTING A REAL-TIME CONTROL PROGRAM TO A PLURALITY OF INPUT/OUTPUT NODES**

[75] **Inventors:** Odo J. Struger, Chagrin Falls; Ernst Dummermuth, Chesterland, both of Ohio

[73] **Assignee:** Allen-Bradley Company, Inc., Milwaukee, Wis.

[21] **Appl. No.:** 686,054

[22] **Filed:** Apr. 15, 1991

[51] **Int. Cl.<sup>5</sup>** ..... G05B 19/05

[52] **U.S. Cl.** ..... 395/200; 364/DIG. 1; 364/221.9; 364/222; 364/188

[58] **Field of Search** ..... 364/188, 200, 221.9, 364/222, 921.2, 921.3; 395/275

[56] **References Cited**

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**Primary Examiner**—Gareth D. Shaw

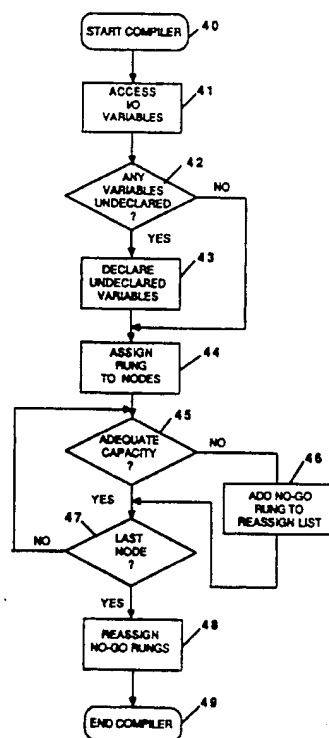
**Assistant Examiner**—John J. B. Backenstose

**Attorney, Agent, or Firm**—Quarles & Brady

[57] **ABSTRACT**

A method for a distributed processing system which includes the steps of developing a control program for controlling outputs at a plurality of I/O nodes, distributing executable portions of the program to the I/O nodes through a network, broadcasting input status data from the I/O nodes on the network and controlling the outputs at the I/O nodes in response to the input status data broadcast on the network and the executable portions of the program residing at the I/O nodes.

**6 Claims, 4 Drawing Sheets**







US005307463A

**United States Patent** [19]

Hyatt et al.

[11] Patent Number: **5,307,463**[45] Date of Patent: **Apr. 26, 1994****[54] PROGRAMMABLE CONTROLLER  
COMMUNICATION MODULE****[75] Inventors:** Craig S. Hyatt, Pewaukee; Emmanuel  
G. D. Hostria, Mukwonago, both of  
Wis.**[73] Assignee:** Allen-Bradley Company, Inc.,  
Milwaukee, Wis.**[21] Appl. No.:** 987,104.**[22] Filed:** Dec. 7, 1992**Related U.S. Application Data****[63]** Continuation of Ser. No. 490,907, Mar. 8, 1990, abandoned.**[51] Int. Cl.<sup>5</sup>** ..... G06F 13/12**[52] U.S. Cl.** ..... 395/275; 364/DIG. 2;  
364/927.92; 364/927.95; 364/927.99;  
364/926.93; 364/940; 364/949; 364/949.91**[58] Field of Search** ..... 395/325, 200, 275, 325;  
364/130, 140, 146, 188**[56] References Cited****U.S. PATENT DOCUMENTS**

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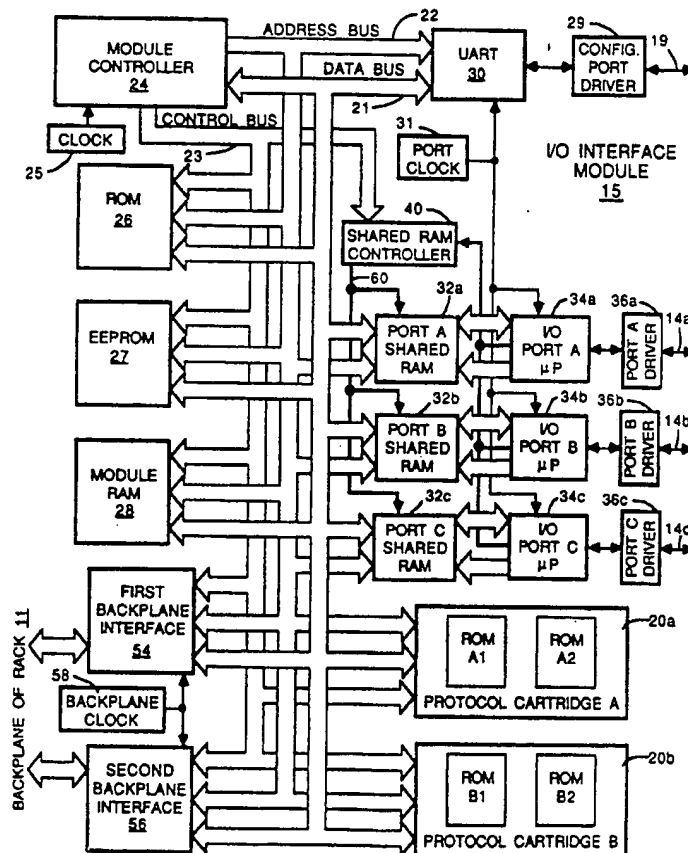
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4,858,101 8/1989 Stewart et al. .... 395/275

*Primary Examiner*—Debra A. Chun*Attorney, Agent, or Firm*—Quarles & Brady**[57] ABSTRACT**

A module interfaces a programmable controller to several serial communication networks for the exchange of data carrying messages. A central processor controls the transfer of data between the module and other programmable controller components. The module has a separate port circuit for each of the networks permitting communication using different protocols. Messages received through one port circuit can be routed to another port circuit or other programmable controller components as specified by routing data stored in the module. The module also can be configured to detect when a given sequence of data is contained in a received message or to parse a section of data from the message. In these cases, an indication of whether the data sequence was found or the parsed data is routed to a designated output of the module.

**8 Claims, 8 Drawing Sheets**



US005321829A

**United States Patent** [19][11] **Patent Number:** **5,321,829****Zifferer**[45] **Date of Patent:** **Jun. 14, 1994**

- [54] **GRAPHICAL INTERFACES FOR MONITORING LADDER LOGIC PROGRAMS**
- [75] Inventor: **Scott C. Zifferer**, Mequon, Wis.
- [73] Assignee: **ICOM, Inc.**, West Allis, Wis.
- [21] Appl. No.: **556,958**
- [22] Filed: **Jul. 20, 1990**
- [51] Int. Cl.<sup>5</sup> ..... **G06F 9/00**
- [52] U.S. Cl. .... **395/575; 395/159; 371/29.1; 364/147; 364/DIG. 1; 364/275.1**
- [58] Field of Search ..... **395/575, 600, 650, 191-192, 395/147, 159; 364/147, 188; 371/29.1**

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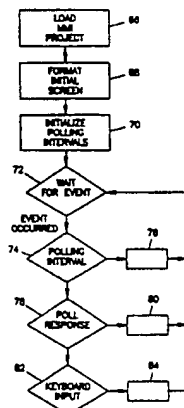
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*Primary Examiner*—Paul V. Kulik*Assistant Examiner*—Jennifer M. Orzech*Attorney, Agent, or Firm*—Merchant, Gould, Smith, Edell, Welter & Schmidt

## [57]

**ABSTRACT**

A menu-driven system for developing Man-Machine Interfaces (MMI) for use in the graphical monitoring of ladder logic programs executing in programmable logic controllers PLCs. The Man-Machine Interfaces graphically depict plant processes controlled by the PLC. Data from the PLC representing plant process events (flows, state changes, tank levels, etc.) are communicated to the Man-Machine Interfaces. A Development System provides a programmer's "tool box" for constructing the Man-Machine Interfaces. Ladder logic programs and databases associated therewith are imported and accessed by the Development System for use in the development of the Man-Machine Interfaces. A Runtime System provides an execution environment for the Man-Machine Interfaces. The Runtime System has the ability to access ladder logic programs during monitoring operations. A user can "hot-key" to the ladder logic program for trouble-shooting purposes.

**12 Claims, 9 Drawing Sheets**

United States Patent [19]  
Fitzgerald et al.

US005349675A  
[11] Patent Number: 5,349,675  
[45] Date of Patent: Sep. 20, 1994

[54] SYSTEM FOR DIRECTLY DISPLAYING  
REMOTE SCREEN INFORMATION AND  
PROVIDING SIMULATED KEYBOARD  
INPUT BY EXCHANGING HIGH LEVEL  
COMMANDS

[75] Inventors: Arthur K. Fitzgerald, Raleigh, N.C.;  
Charles W. Gainey, Jr.,  
Poughkeepsie, N.Y.; William K.  
Kelley, Wappingers Falls, N.Y.;  
Samuel L. Wentz, Endwell, N.Y.

[73] Assignee: International Business Machines  
Corporations, Armonk, N.Y.

[21] Appl. No.: 577,967

[22] Filed: Sep. 4, 1990

[51] Int. Cl.<sup>5</sup> ..... G06F 15/16

[52] U.S. Cl. .... 395/800; 395/325;  
395/500; 395/161; 364/221; 364/DIG. 1

[58] Field of Search ..... 395/800, 600, 325, 161,  
395/500; 364/421, 300, 419; 273/85 G;  
358/143; 345/196

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Primary Examiner—Thomas C. Lee

Assistant Examiner—Paul R. Lintz

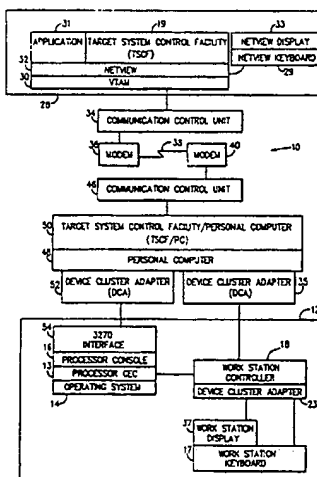
Attorney, Agent, or Firm—Arthur J. Samodovitz

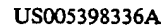
[57]

ABSTRACT

A computer network has a first computer which is locally coupled to a second computer. The first computer controls operation of the second computer according to a plurality of high level commands obtained from a third computer at a central station. The third computer includes apparatus for receiving the high level commands either from a program running on the third computer or an operator interface on the third computer. A communication facility is provided between the third computer and the first computer to transmit the high level commands to the first computer. The first computer includes a plurality of relatively low level programs corresponding respectively to the plurality of high level operation commands. Each of the low level programs implements the corresponding high level command to control operation of the first computer. The first computer also includes means for selecting the corresponding low level program in response to receipt of the high level command. One of the high level commands is Activate, and the corresponding low level program implements power on, initial microprogram load, and initial program load on the second computer in response to the Activate command.

6 Claims, 14 Drawing Sheets





**[11] Patent Number: 5,398,336**

[45] **Date of Patent:** Mar. 14, 1995

- "The C++ Programming Language" by Bjarne Stroustrup, 1986.  
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*Primary Examiner*—Kevin A. Kriess  
*Assistant Examiner*—Kakali Chaki  
*Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman

[57] **ABSTRACT**

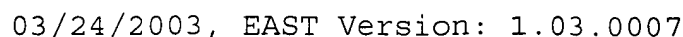
- An object-oriented architecture for a factory floor management software system is described in which factory floor entities are modelled as factory objects within a relational database. The architecture includes X-terminal or bar code devices for facilitating user interaction with the system via one or more of the factory floor entities; Application Engines for processing user interaction of events and generating application service requests; and Application servers for processing the application service requests and generating database service requests in response. These database service requests are utilized to retrieve, manipulate and update data stored within the relational database. Communication Managers are employed for coordinating interprocess communication between the Application Engines, the Application Servers, and the Database Servers. Each of these major components are distributed among computer resources that are networked across the factory floor.

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**15 Claims, 7 Drawing Sheets**



# United States Patent [19]

Yoshikura et al.

US005406473A

[11] Patent Number: 5,406,473

[45] Date of Patent: Apr. 11, 1995

## [54] PROGRAMMABLE CONTROLLER

[75] Inventors: Fuyuhiko Yoshikura, Nagoya; Teiji Uno, Kariya, both of Japan

[73] Assignee: Toyota Jidosha Kabushiki Kaisha, Aichi, Japan

[21] Appl. No.: 95,040

[22] Filed: Jul. 21, 1993

### Related U.S. Application Data

[63] Continuation of Ser. No. 673,005, Mar. 21, 1991, abandoned.

### [30] Foreign Application Priority Data

Mar. 24, 1990 [JP] Japan ..... 2-74521

[51] Int. Cl.<sup>6</sup> ..... G06F 13/14

[52] U.S. Cl. .... 364/140; 364/133

[58] Field of Search ..... 364/136, 138, 140, 141, 364/147, 131-135, 188-193; 395/133

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Primary Examiner—Roy N. Envall, Jr.

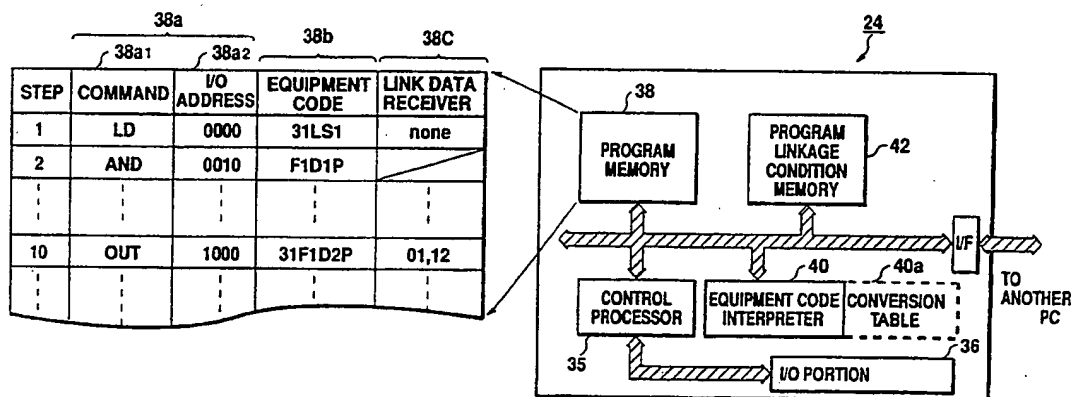
Assistant Examiner—Thomas E. Brown

Attorney, Agent, or Firm—Finnegan, Henderson, Farabow, Garrett & Dunner.

### [57] ABSTRACT

A programmable controller (PC) for controlling equipments in accordance with a sequence program. A program memory is provided with an equipment code storage region for storing global equipment codes for indicating the equipments each of which is allotted an individual I/O address. When an equipment code is input, an equipment code interpreter determines the local I/O address which corresponds to the equipment code. The equipment code is composed of a PC number code, an equipment type code, an equipment number code and the like. The equipment code is displayed together with the sequence program.

4 Claims, 13 Drawing Sheets





US005420977A

**United States Patent** [19][11] **Patent Number:** **5,420,977**

Sztipanovits et al.

[45] **Date of Patent:** **May 30, 1995**

[54] **MULTIPLE ASPECT OPERATOR INTERFACE FOR DISPLAYING FAULT DIAGNOSTICS RESULTS IN INTELLIGENT PROCESS CONTROL SYSTEMS**

[75] **Inventors:** Janos Sztipanovits; Csaba Biegl; Gabor Karsai; Samir Padalkar, all of Nashville, Tenn.; Nobuji Miyasaka, Toyonaka; Koji Okuda, Nishinomiya, both of Japan

[73] **Assignees:** Vanderbilt University, Nashville, Tenn.; Osaka Gas Co., Ltd., Osaka, Japan

[21] **Appl. No.:** 135,313

[22] **Filed:** Oct. 12, 1993

**Related U.S. Application Data**

[63] Continuation of Ser. No. 602,944, Oct. 24, 1990, abandoned.

[51] **Int. Cl.<sup>6</sup>** ..... G06F 19/00

[52] **U.S. Cl.** ..... 395/160; 395/161

[58] **Field of Search** ..... 395/155, 157, 160, 161

[56] **References Cited****U.S. PATENT DOCUMENTS**

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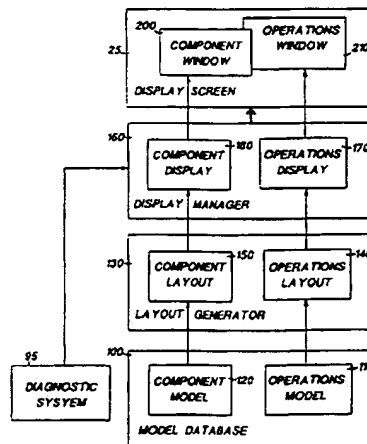
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*Primary Examiner*—Mark K. Zimmerman  
*Attorney, Agent, or Firm*—Fish & Richardson

## [57]

**ABSTRACT**

In a fault diagnostic system, an operator interface simultaneously displays an operations hierarchy and a components hierarchy in two separate windows. The display system is used with a model-based diagnostic system that monitors operational parameters of an industrial process. The diagnostic system identifies possible failure source components in the industrial process and the display system uses these diagnostics to display the most interesting portions of the operations hierarchy and the components hierarchy. The most interesting node, to be displayed with its subtree, is defined as the node at the lowest level of the hierarchy that is both a fault source and that has more children than other fault sources at that level.

**6 Claims, 5 Drawing Sheets**



US005440699A

**United States Patent** [19]

Farrand et al.

[11] **Patent Number:** **5,440,699**[45] **Date of Patent:** **Aug. 8, 1995**

[54] **SYSTEM BY WHICH A REMOTE COMPUTER RECEIVES SCREEN IMAGES FROM AND TRANSMITS COMMANDS TO A HOST COMPUTER**

[75] **Inventors:** Scott C. Farrand, Tomball; Patrick E. Dobyns, Garland; Thomas J. Hernandez, Houston; Ronald A. Neyland, Spring; Richard A. Stupek, Houston; Said S. Saadeh; Paul R. Fulton, both of Plano; Richard P. Mangold, Tomball; Andrew J. Miller, Houston, all of Tex.

[73] **Assignee:** Compaq Computer Corporation, Houston, Tex.

[21] **Appl. No.:** 282,824

[22] **Filed:** Jul. 29, 1994

**Related U.S. Application Data**

[63] Continuation of Ser. No. 719,243, Jun. 24, 1991, abandoned.

[51] **Int. Cl.<sup>6</sup>** ..... G06F 3/00

[52] **U.S. Cl.** ..... 395/155; 364/DIG. 1; 364/227.1; 364/234; 395/500; 395/700; 395/200.03; 395/200.12

[58] **Field of Search** ..... 360/222.1, 234; 395/700, 500, 325, 155

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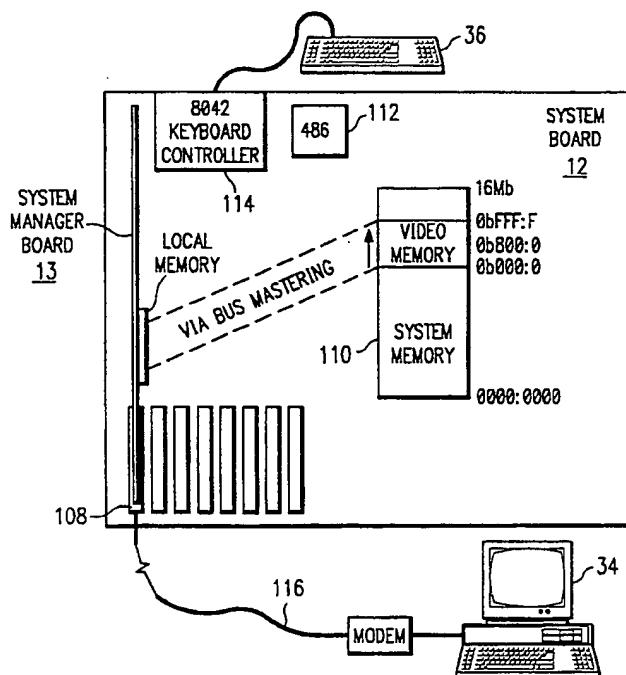
*Primary Examiner*—Kevin A. Kriess

*Assistant Examiner*—J. Backenstose

*Attorney, Agent, or Firm*—Jenkins & Gilchrist

[57] **ABSTRACT**

A remote console emulation for a computer system manager operates by transferring video screen images from system memory to the remote console and by inserting keystrokes from the remote console into the system keyboard controller. This emulation constitutes a marked improvement over prior art emulations because it does not require software on the host system.

**15 Claims, 4 Drawing Sheets**



US00544686A

**United States Patent** [19][11] **Patent Number:** **5,446,868****Gardea, II et al.**[45] **Date of Patent:** **Aug. 29, 1995****[54] NETWORK BRIDGE METHOD AND APPARATUS**

[75] Inventors: **Raymond A. Gardea II**,  
Winston-Salem; **Martin D.**  
**Covington, Jr.**, Rural Hall; **Brent W.**  
**Carter**, Jamestown; **Forrest W.**  
**Bowling**, Winston-Salem, all of N.C.

[73] Assignee: **R. J. Reynolds Tobacco Company**,  
Winston-Salem, N.C.

[21] Appl. No.: **943,635**

[22] Filed: **Sep. 11, 1992**

[51] Int. Cl.<sup>6</sup> ..... **G06F 13/42; G06F 15/173**

[52] U.S. Cl. .... **395/500; 364/222.2;**  
**364/228; 364/229; 364/240.8; 364/242.95;**  
**364/260.9; 364/284.4**

[58] Field of Search ..... **395/500, 800, 200;**  
**370/85.13**

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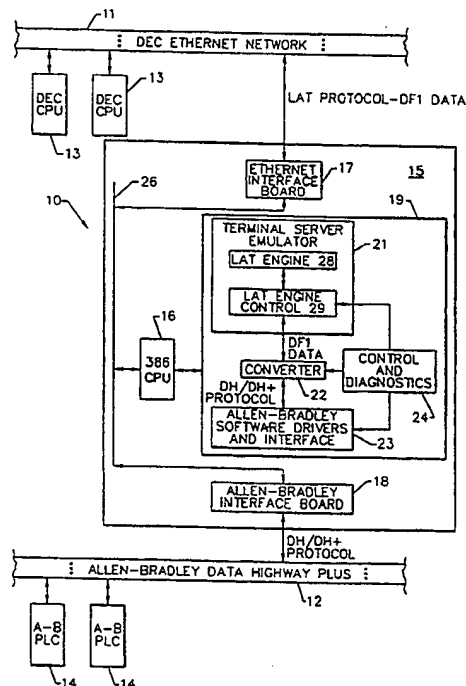
*Primary Examiner*—Parshotam S. Lall

*Assistant Examiner*—Ayni Mohamed

[57]

**ABSTRACT**

A network bridge between a DEC Ethernet network using LAT protocol and an Allen-Bradley Data Highway/Data Highway Plus (DH/DH+) network eliminates the need to use a DEC terminal server and Allen-Bradley KE/KF2 interface with their low data rates. A terminal server emulator is electrically connected to the DEC Ethernet network for stripping the LAT protocol from the DEC Ethernet network and provide DF1 formatted data. A converter module is electrically connected between the terminal server emulator and the DH/DH+ network for converting the DF1 data into DH/DH+ protocol data and for transmitting this data to the DH/DH+ network. The converter also converts data using DH/DH+ protocol which is received from the DH/DH+ network into DF1 data and transmits this data to the terminal server emulating means. The terminal server emulating means then places the DF1 formatted data into LAT packets and transmits the LAT packets to the Ethernet network. The terminal server preferably includes a commercially available LAT engine. The terminal server emulator and the converter preferably run on a general purpose microcomputer which includes an Ethernet interface board and an Allen-Bradley interface board.

**19 Claims, 17 Drawing Sheets**





US005528503A

**United States Patent** [19][11] **Patent Number:** **5,528,503****Moore et al.**[45] **Date of Patent:** **Jun. 18, 1996****[54] INTEGRATED AUTOMATION  
DEVELOPMENT SYSTEM AND METHOD****OTHER PUBLICATIONS****[75] Inventors:** **Stephen F. Moore**, Lewisville; **Thomas E. Byrd**, Allan, both of Tex.

'Monolithische Programmierung—ein Verfahren zur Programmierung verteilter heterogener Automatisierungssysteme' AT Automatisierungstechnik, vol. 39, No. 10, Oct. 1991, München, de p. 344–353, XP000265596 Heinrich Weber. p. 350 right column, last paragraph—p. 352, left column, paragraph 3\*.

**[73] Assignee:** **Texas Instruments Incorporated**, Dallas, Tex.

'Semiconductor CIM Standard Solution' Proceedings of the Industrial Computing Conference, vol. 2, 23 Oct. 1992, Houston, Texas, USA pp. 367–374, XP000344870.

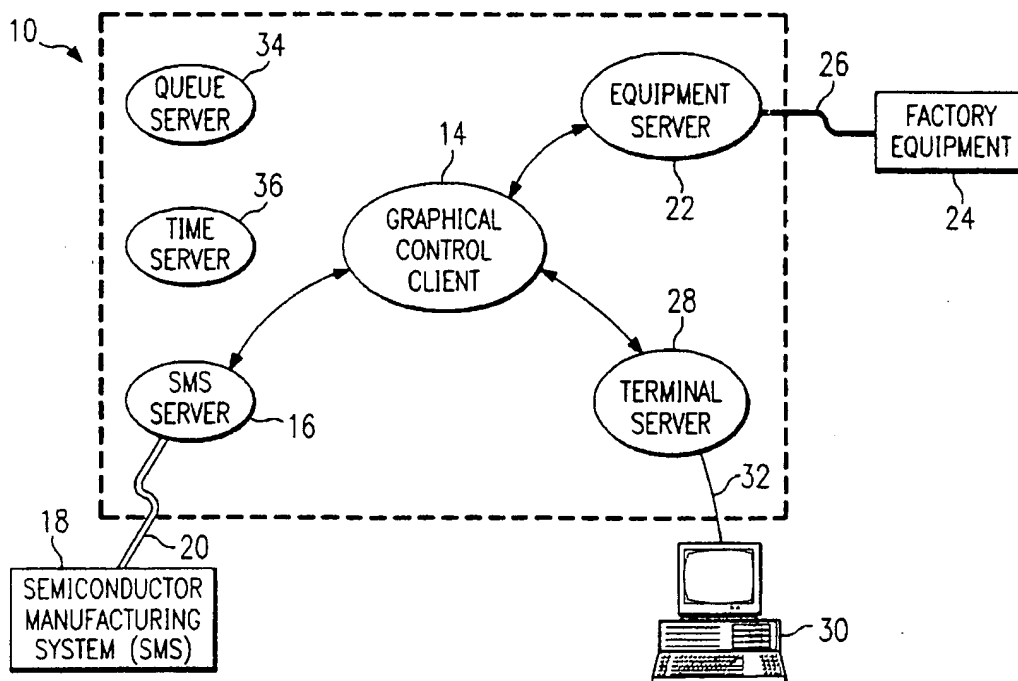
**[21] Appl. No.:** **56,007****[22] Filed:** **Apr. 30, 1993****[51] Int. Cl.<sup>6</sup> ..... G06F 19/00****Primary Examiner**—James P. Trammell**[52] U.S. Cl. .... 364/468; 364/131****Attorney, Agent, or Firm**—W. Daniel Swayze, Jr.; W. James Brady, III; Richard L. Donaldson**[58] Field of Search .... 364/468, 474.11,  
364/131–139; 395/725, 575, 650, 200,  
155****[57] ABSTRACT****[56] References Cited****U.S. PATENT DOCUMENTS**

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An integrated automation development system (10) for controlling and coordinating manufacturing equipment (24) employs a plurality of server processes (14, 16, 22, 28, 34, 36). Each server process includes a messaging manager (45) for receiving ASCII messages, and an interpreter (43) for evaluating the received ASCII messages and identifying commands within the messages. The server process further includes a command manager (41) for receiving and executing the commands, and a logic controller (47) for managing the logic flow of the command execution by the command manager (41). The servers may include additional commands (48) that enable them to serve as queue servers (34), terminal servers (28), and other application-specific server processes.

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**19 Claims, 7 Drawing Sheets**



US005598536A

# United States Patent [19]

Slaughter, III et al.

[11] Patent Number: **5,598,536**  
 [45] Date of Patent: **Jan. 28, 1997**

[54] APPARATUS AND METHOD FOR PROVIDING REMOTE USERS WITH THE SAME UNIQUE IP ADDRESS UPON EACH NETWORK ACCESS

[75] Inventors: Frank G. Slaughter, III, Weston; Russell C. Gocht, Bedford; David McCool, Tewksbury, all of Mass.

[73] Assignee: Shiva Corporation, Burlington, Mass.

[21] Appl. No.: 287,775

[22] Filed: Aug. 9, 1994

[51] Int. Cl.<sup>6</sup> ..... H04J 3/02

[52] U.S. Cl. .... 395/200.16; 395/200.15; 379/95

[58] Field of Search ..... 395/200.09, 200.06, 395/200.15, 200.16

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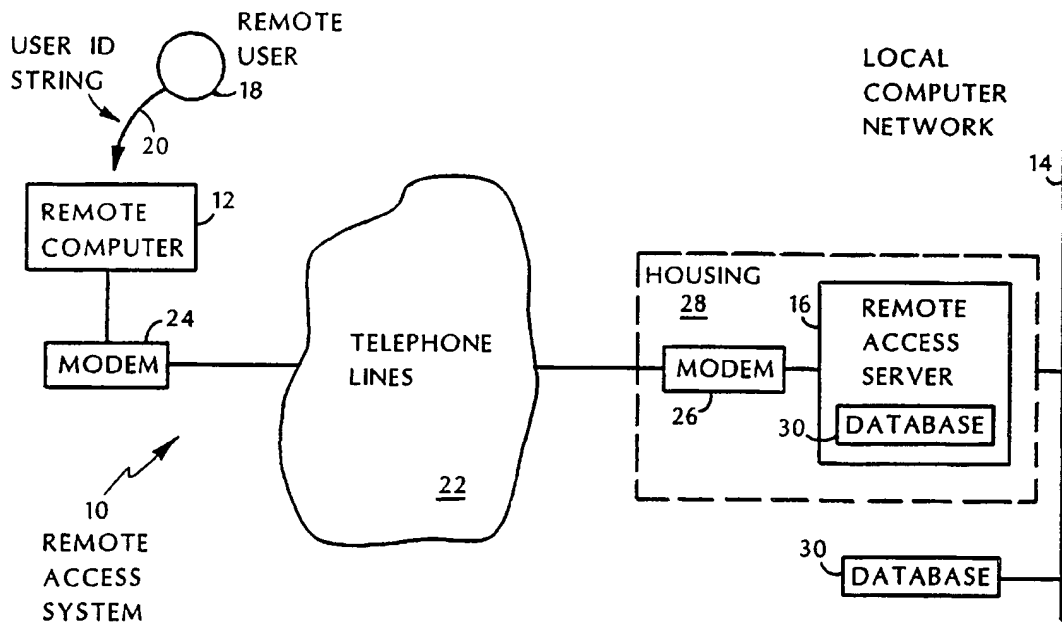
Primary Examiner—Krisna Lim

Attorney, Agent, or Firm—Fish & Richardson, P.C.

## [57] ABSTRACT

A remote access server provides a remote user with access to a local computer network. The server receives a user identification string from its communication port, the string having been entered by the remote user at a remote computer which is coupled to the communication port. The string identifies the remote user. The server uses the string to access a database and determine an internet protocol (IP) address associated with the string. The remote computer needs the IP address to communicate on the local computer network. The database includes a user identification string for each remote user and an IP address for each string. The remote access server sends the IP address to the remote computer via the communication port. The server then allows the remote computer to access the local computer network and to communicate on the local computer network using the IP address.

19 Claims, 2 Drawing Sheets





US005613115A

**United States Patent** [19]

Gihl et al.

[11] **Patent Number:** 5,613,115[45] **Date of Patent:** Mar. 18, 1997

[54] **METHOD FOR USING PLC PROGRAMMING INFORMATION TO GENERATE SECONDARY FUNCTIONS SUCH AS DIAGNOSTICS AND OPERATOR INTERFACE**

[75] Inventors: **Nicholas T. Gihl, Elmhurst; John R. Skach, Palatine, both of Ill.**

[73] Assignee: **Total Control Products, Inc., Melrose Park, Ill.**

[21] Appl. No.: **804,010**

[22] Filed: **Dec. 9, 1991**

[51] Int. Cl.<sup>6</sup> ..... **G06F 9/06; G06F 15/46**

[52] U.S. Cl. .... **395/701; 395/800; 395/376; 364/146; 364/147; 364/926.93**

[58] Field of Search ..... **364/DIG. 1, DIG. 2; 395/700**

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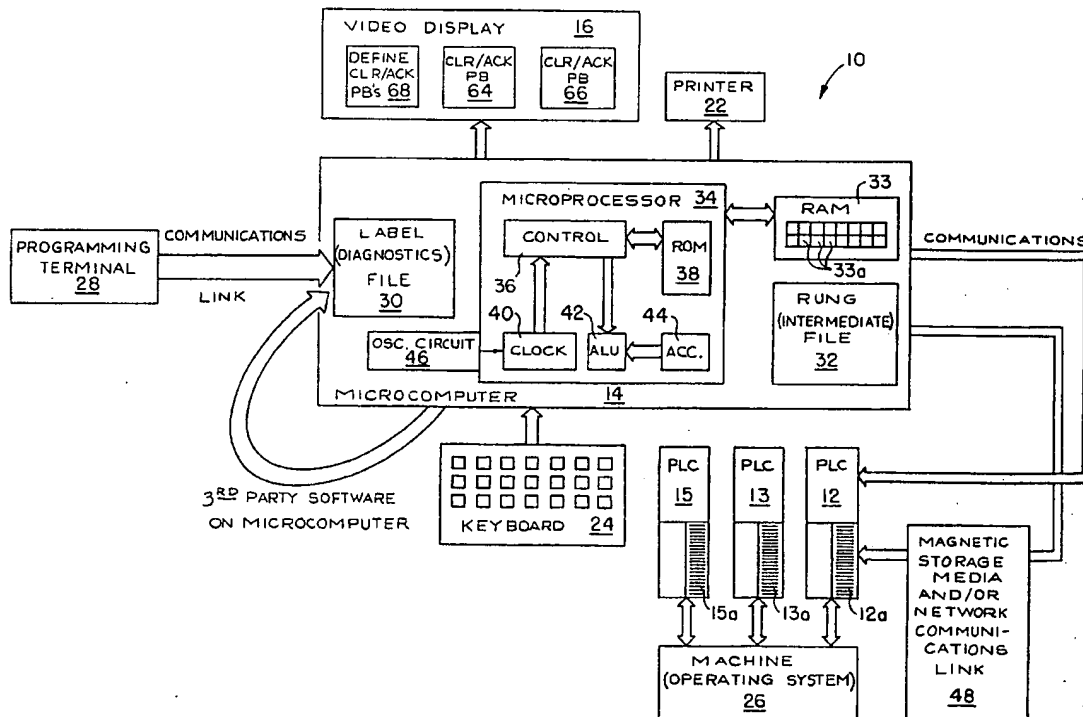
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*Primary Examiner*—Kevin A. Kriess  
*Assistant Examiner*—Lucien Toplu  
*Attorney, Agent, or Firm*—Emrich & Dithmar

[57] **ABSTRACT**

A programmable logic controller (PLC) in an operating system such as a machine includes a software development tool having labels in a first field to identify and describe specific input/output (I/O) points in the PLC. Each label assignment can be used in the formation of rungs in a ladder logic array to facilitate programming of the PLC. The PLC also allows for the entry of descriptive comments in a second comment field associated with each label assignment to assist the programmer. Secondary function instructions replace the descriptive comments in the comment portion of a label, or in the comment field, to generate a diagnostic, or status, indication such as an alarm for the machine when executed by the PLC. Comments for labels are transformed by a translator, with a file containing the labels and associated comments accessed and scanned for label comments with the appropriate syntax. Secondary function instructions are recognized by the use of specific key words in the comment field. Other functions not part of PLC control of the machine, such as operator interface with the system, may also be programmed into the comment field for performing secondary functions in a manner which facilitates programming of the PLC and makes more efficient use of PLC memory.

**17 Claims, 3 Drawing Sheets**





US005623652A

**United States Patent** [19][11] **Patent Number:** **5,623,652****Vora et al.**[45] **Date of Patent:** **Apr. 22, 1997**

[54] **METHOD AND APPARATUS FOR SEARCHING FOR INFORMATION IN A NETWORK AND FOR CONTROLLING THE DISPLAY OF SEARCHABLE INFORMATION ON DISPLAY DEVICES IN THE NETWORK**

[75] Inventors: **Kumar A. Vora**, San Jose; **Gregory B. Vaughan**, Santa Cruz; **Kenneth C. McLeod**, Santa Clara; **David Casseres**, Palo Alto, all of Calif.

[73] Assignee: **Apple Computer, Inc.**, Cupertino, Calif.

Brian Morgan, "Business Objects", DBMS, vol.5 No. 10, pp. 28-30, Sep. 1992.

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*Primary Examiner*—Wayne Amsbury

*Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman

[21] Appl. No.: **280,274**

[22] Filed: **Jul. 25, 1994**

[51] Int. Cl.<sup>6</sup> ..... **G06F 17/30**

[52] U.S. Cl. .... **395/610; 364/DIG. 1; 364/282.1; 364/282.4; 364/283.3; 395/602**

[58] Field of Search ..... **395/600**

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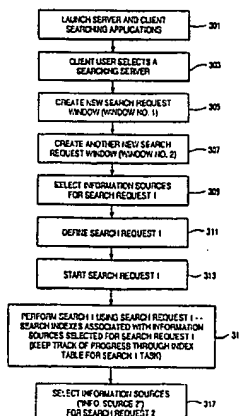
Lexis-Nexis, "The Eclipse", Instructions.

PCT Foreign Search Report, Nov. 24, 1995.

[57] **ABSTRACT**

A method an apparatus for maintaining information in a network of computer systems and for controlling the display of searchable information. The apparatus includes a first processor having a first display device and being coupled to an information storage device having information stored in at least one information source, where the first processor is coupled to a network. An input device is coupled to the first processor, where the input device is for selecting the information source to provide a selected information source which is to be unavailable for searching. A second processor having a second display device is coupled to the network to communicate with the first processor. The second display device is for displaying an indicia of information source, where the second display device displayed the indicia of the information source when the information source has not been selected by the input device. When the input device has selected the information source the indicia at some point in time after the information source has been selected is no longer displayed on the second display device. The method includes displaying on a first display device to a first indicia which corresponds to an information source stored on an information storage device. The method further includes displaying on the second display device a second indicia corresponding to the information source, this second indicia being displayed when the information source is not selected by the input device. When the information source is selected, at some time after selection, the second indicia is longer displayed on the second display device.

**2 Claims, 15 Drawing Sheets**





US005625781A

**United States Patent** [19]

Cline et al.

[11] Patent Number: **5,625,781**[45] Date of Patent: **Apr. 29, 1997**[54] **ITINERARY LIST FOR INTERFACES**

[75] Inventors: **Troy L. Cline**, Cedar Park; **Ricky L. Poston**, Austin, both of Tex.; **Jon H. Werner**, Oceanside, Calif.

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **551,016**

[22] Filed: **Oct. 31, 1995**

[51] Int. Cl.<sup>6</sup> ..... **G06F 15/00**

[52] U.S. Cl. .... **395/335; 395/356; 395/357**

[58] Field of Search ..... **395/154, 155, 395/156, 157, 160, 161**

[56] **References Cited****U.S. PATENT DOCUMENTS**

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*Primary Examiner*—Raymond J. Bayerl

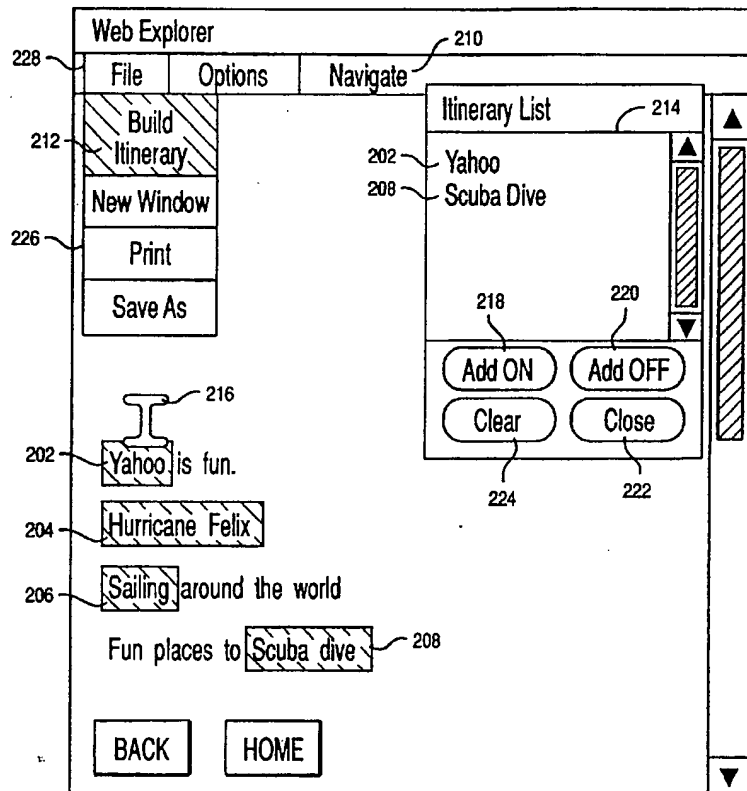
*Assistant Examiner*—Huynh Ba

*Attorney, Agent, or Firm*—Diana L. Roberts

[57] **ABSTRACT**

A uniquely programmed computer system, computer-implemented method, and computer readable memory embodying computer-readable detail logic direct a computer system to create a temporary list of links. The present invention creates the list of links without having to first open/visit the corresponding site to each link in the list or having to manually enter the name and address of the sites. The method includes placing the computer system in an itinerary mode, wherein the links lose their original function of opening/visiting the corresponding site when selected. The method includes displaying the list on a first portion of the display. The method includes selecting from a second portion of the display at least one link to be placed in the list. The method includes opening/visiting and displaying the site corresponding to the selected link on the second portion of the display in response to a selection of at least one link placed in the list.

**11 Claims, 4 Drawing Sheets**



200



US005699350A

# United States Patent [19]

Kraslavsky

[11] Patent Number: 5,699,350

[45] Date of Patent: Dec. 16, 1997

[54] RECONFIGURATION OF PROTOCOL STACKS AND/OR FRAME TYPE ASSIGNMENTS IN A NETWORK INTERFACE DEVICE

[75] Inventor: Andrew J. Kraslavsky, Rancho Santa Margarita, Calif.

[73] Assignee: Canon Kabushiki Kaisha, Tokyo, Japan

[21] Appl. No.: 540,227

[22] Filed: Oct. 6, 1995

[51] Int. Cl.<sup>6</sup> ..... G06F 13/14; H04J 3/26

[52] U.S. Cl. .... 370/254; 370/389; 370/420; 395/182.02; 395/200.1; 395/200.15; 395/200.2

[58] Field of Search ..... 340/825.06, 825.08, 340/825.22, 825.5, 825.51; 395/181, 182.01, 182.02, 200.02, 200.1, 200.11, 200.12, 200.15, 200.2, 500, 800, 828, 830, 831; 370/241, 250, 254, 389, 400, 401, 420, 449, 465, 469

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5,386,412	1/1995	Park et al.	370/53
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5,509,123	4/1996	Dobbins et al.	395/200.15
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5,537,626	7/1996	Kraslavsky et al.	395/828

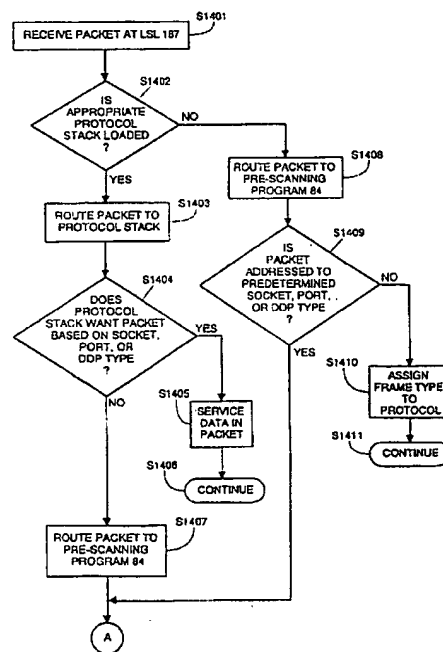
Primary Examiner—Alpus H. Hsu

Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

## [57] ABSTRACT

A network interface device which can communicate with other devices via a local area network (LAN) using various protocols and frame types, and which can be remotely reconfigured to use different protocols and frame types. The network interface device includes a LAN interface that receives packets including address and data information from the LAN and transmits packets to the LAN. The network interface device also includes a processor that (i) executes an initialization routine to load protocol stack modules and to assign a frame type for each of the loaded protocol stack modules based on configuration information regarding the protocols and frame types used on the LAN, (ii) determines whether a packet received from the LAN is a configuration packet by detecting whether the received packet is addressed to a predetermined address, and (iii) alters the configuration information using the data in the configuration packet, in response to a determination that the received packet is a configuration packet, and changes the configuration of at least one of (i) the loaded protocol stacks and (ii) the frame type assignments based on the altered configuration information.

52 Claims, 20 Drawing Sheets





US005734831A

**United States Patent** [19]

Sanders

[11] Patent Number: **5,734,831**[45] Date of Patent: **Mar. 31, 1998**[54] **SYSTEM FOR CONFIGURING AND REMOTELY ADMINISTERING A UNIX COMPUTER OVER A NETWORK**[75] Inventor: **James B. Sanders**, Menlo Park, Calif.[73] Assignee: **Sun Microsystems, Inc.**, Mountain View, Calif.[21] Appl. No.: **639,129**[22] Filed: **Apr. 26, 1996**[51] Int. Cl.<sup>6</sup> ..... **G06F 17/00**[52] U.S. Cl. .... **395/200.53**

[58] Field of Search ..... 395/200.53, 200.5, 395/200.51, 200.52, 712, 762, 651, 652, 653; 364/131, 133; 340/825.15

[56] **References Cited****U.S. PATENT DOCUMENTS**

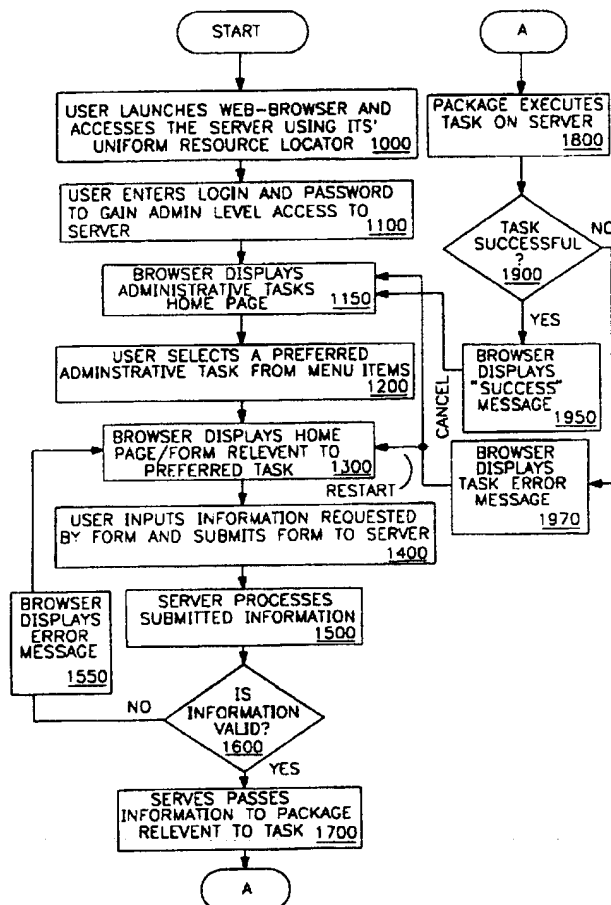
5,426,421 6/1995 Gray ..... 340/825.15

Primary Examiner—Ellis B. Ramirez

Attorney, Agent, or Firm—Blakely Sokoloff Taylor &amp; Zafman

[57] **ABSTRACT**

A forms based browser interface system for configuring and administering a network server from a remote location. Using forms, such as hyper-text markup language forms, the system provides a graphical user interface that allows a novice user, unaware of the platform, architecture or even operating system of the network server, to transact administrative tasks on the network server. An interfacing computer, at which the novice user performs administrative tasks upon the network server, is connected to the network server via network connections. The interfacing computer is equipped with a browser program that can display and interact with the forms created by the network server. The forms allow the user to select among various administrative tasks to be performed on the server. The forms also allow the user to input parameters for administration of the server such as new account names when adding new accounts for the server. Once the form input is submitted over the network connections to the network server, scripts within the server pass this information as parameters to appropriate software that complete the execution of the task and may signal to the user at the interfacing computer, through messages on the forms, success or failure thereof.

**16 Claims, 8 Drawing Sheets**



US005805442A

**United States Patent** [19]  
**Crater et al.**

[11] **Patent Number:** **5,805,442**  
 [45] **Date of Patent:** **Sep. 8, 1998**

[54] **DISTRIBUTED INTERFACE  
 ARCHITECTURE FOR PROGRAMMABLE  
 INDUSTRIAL CONTROL SYSTEMS**

[75] Inventors: **Kenneth C. Crater**, North Grafton;  
**Craig E. Goldman**, Natick, both of  
 Mass.

[73] Assignee: **Control Technology Corporation**,  
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[21] Appl. No.: **655,469**

[22] Filed: **May 30, 1996**

[51] Int. Cl.<sup>6</sup> ..... **G06F 13/14**

[52] U.S. Cl. .... **364/138; 364/131; 340/825.07;  
 395/200.49; 395/200.5; 395/200.58; 345/346**

[58] Field of Search ..... **364/138, 131,  
 364/146, 147, 136, 141, 183; 395/701,  
 200.31, 821, 356, 200.49, 200.5, 200.58;  
 340/825.07; 345/346**

[56] **References Cited**

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*Primary Examiner*—Hezrone E. Williams

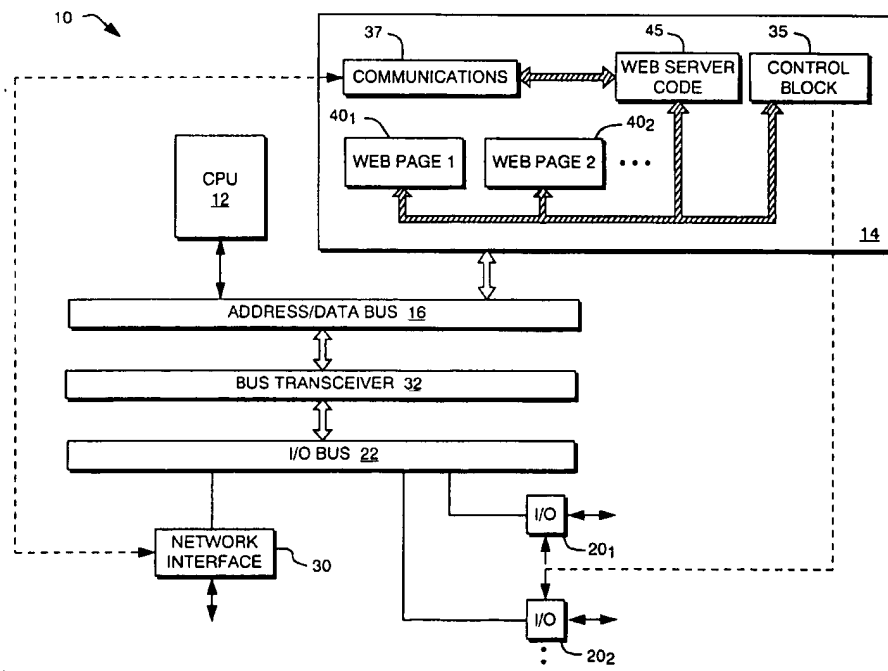
*Assistant Examiner*—Hien Vo

*Attorney, Agent, or Firm*—Cesari & McKenna, LLP

[57] **ABSTRACT**

An integrated control system comprises one or more controllers each equipped to perform a control function and to gather data (ordinarily from sensors) relevant to the control function. Each controller contains computer storage means, such as computer memory, for storing the relevant data and instructions, associated with the data, for causing a remote computer to generate a visual display incorporating the data in a predetermined format; and a communication module for establishing contact and facilitating data interchange with the remote computer. The remote computer, in turn, also includes a communication module compatible with the controller-borne module, and which enables the remote computer to download the data and associated instructions from one or more controllers. The remote computer also includes a facility for processing the instructions to create a user interface encoded by the instructions, and which incorporates the data. In this way, controller data is coupled to instructions for displaying that data, and this totality of information is continuously accessible, on a freely selective basis, to the remote computer.

**22 Claims, 2 Drawing Sheets**







US005950006A

**United States Patent** [19]  
**Crater et al.**

[11] **Patent Number:** **5,950,006**  
[45] **Date of Patent:** **Sep. 7, 1999**

[54] **OBJECT-ORIENTED PROGRAMMABLE  
CONTROLLER**

[75] Inventors: **Kenneth C. Crater**, North Grafton;  
**Daniel L. Pierson**, Hudson, both of  
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[73] Assignee: **Control Technology Corporation**,  
Hopkinton, Mass.

[21] Appl. No.: **08/964,998**

[22] Filed: **Nov. 5, 1997**

[51] Int. Cl.<sup>6</sup> ..... **G06F 9/45**

[52] U.S. Cl. .... **395/705**

[58] Field of Search ..... **395/705**

[56] **References Cited**

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*Primary Examiner*—Tariq R. Hafiz

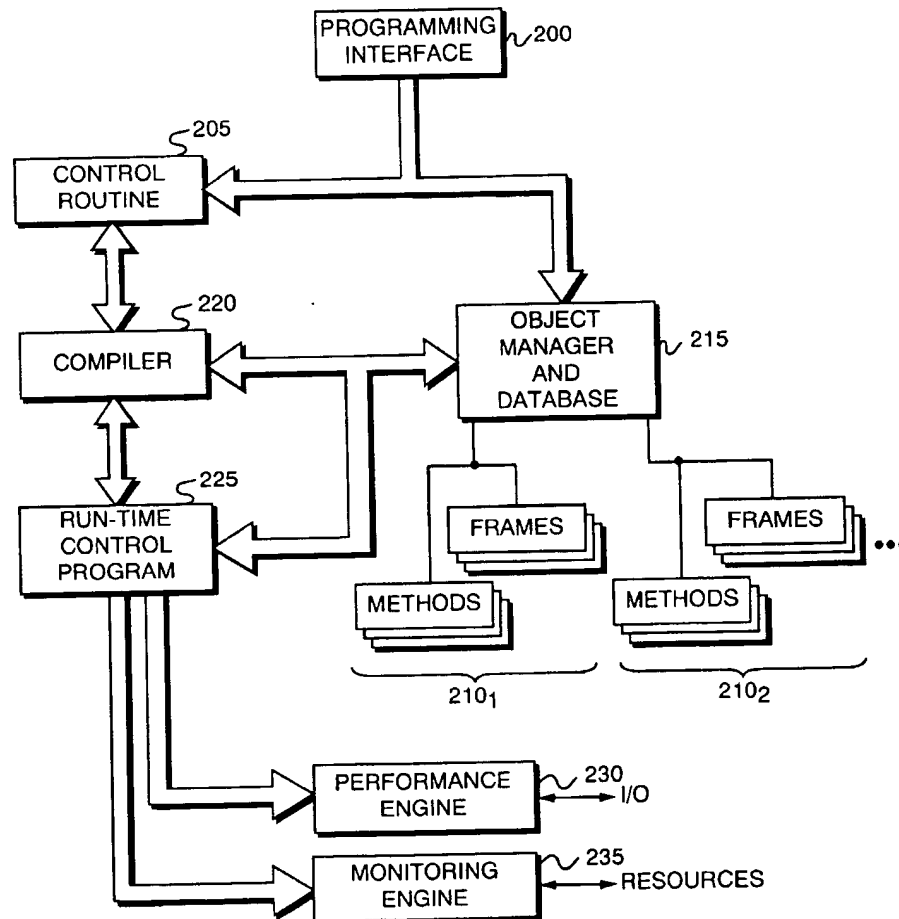
*Assistant Examiner*—Wei Zhen

*Attorney, Agent, or Firm*—Cesari and McKenna, LLP

[57] **ABSTRACT**

A controller for one or more pieces of industrial equipment is configured to perform a series of control functions each organized into one or more procedures for performing particular machine actions. The progress of an action, or some parameter of the action-taking machine (which may or may not be associated with an action), is represented by one or more "states." A database associates entries corresponding to the items of an object (including the action(s) and the state(s)), and contains storage locations where the associated procedural instructions and/or data are to be found. The action can be independent of state information, or can instead be executed in a manner responsive to a sensed state. The controller may also include diagnostic capability, as well as accumulation and processing of performance data for subsequent analysis.

**16 Claims, 7 Drawing Sheets**





US005975737A

# United States Patent [19]

Crater et al.

[11] Patent Number: 5,975,737

[45] Date of Patent: \*Nov. 2, 1999

## [54] DISTRIBUTED INTERFACE ARCHITECTURE FOR PROGRAMMABLE INDUSTRIAL CONTROL SYSTEMS

[75] Inventors: Kenneth C. Crater, North Grafton;  
Craig E. Goldman, Natick, both of  
Mass.

[73] Assignee: Control Technology Corporation,  
Hopkinton, Mass.

[\*] Notice: This patent is subject to a terminal disclaimer.

[21] Appl. No.: 09/112,583

[22] Filed: Jul. 9, 1998

### Related U.S. Application Data

[63] Continuation of application No. 08/655,469, May 30, 1996,  
Pat. No. 5,805,442.

[51] Int. Cl.<sup>6</sup> ..... G06F 13/14

[52] U.S. Cl. .... 364/138; 364/131; 709/219;  
709/220; 709/228

[58] Field of Search ..... 364/138, 131,  
364/147; 395/183.14, 183.22, 821; 709/219,  
220, 228

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Primary Examiner—Marc S. Hoff

Assistant Examiner—Hien Vo

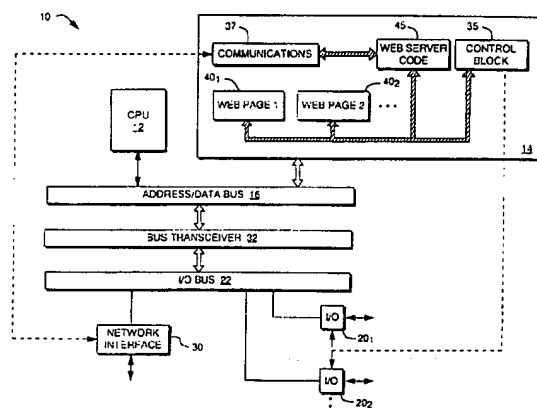
Attorney, Agent, or Firm—Cesari and McKenna, LLP

[57]

### ABSTRACT

An integrated control system comprises one or more controllers each equipped to perform a control function and to gather data (ordinarily from sensors) relevant to the control function. Each controller contains computer storage means, such as computer memory, for storing the relevant data and instructions, associated with the data, for causing a remote computer to generate a visual display incorporating the data in a predetermined format; and a communication module for establishing contact and facilitating data interchange with the remote computer. The remote computer, in turn, also includes a communication module compatible with the controller-borne module, and which enables the remote computer to download the data and associated instructions from one or more controllers. The remote computer also includes a facility for processing the instructions to create a user interface encoded by the instructions, and which incorporates the data. In this way, controller data is coupled to instructions for displaying that data, and this totality of information is continuously accessible, on a freely selective basis, to the remote computer.

14 Claims, 2 Drawing Sheets





**[11] Patent Number: 5,982,362**

[45] **Date of Patent:** Nov. 9, 1999

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- [22] Filed: May 6, 1997

### Related U.S. Application Data

- [63] Continuation-in-part of application No. 08/655,469, May 30, 1996, Pat. No. 5,805,442.

- [51] Int. Cl.<sup>6</sup> ..... H04N 7/14; H04H 1/02

- [52] U.S. Cl. .... 345/327; 348/12; 348/13;  
455/5.1; 709/219

- [58] **Field of Search** ..... 709/217-219;  
348/6, 7, 10, 12, 13, 143; 455/3.1, 3.2,  
4.1, 4.2, 5.1, 6.1, 6.2, 6.3; 345/326, 327

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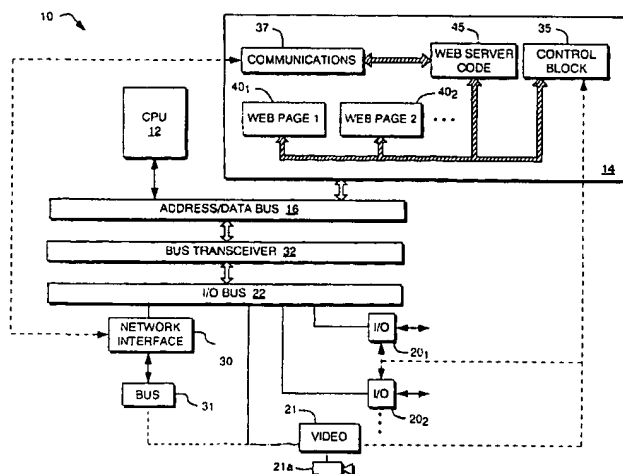
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**23 Claims, 2 Drawing Sheets**





[11] Patent Number: 5,997,167

[45] **Date of Patent:** Dec. 7, 1999

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- Primary Examiner*—Paul P. Gordon  
*Assistant Examiner*—Victoria Robinson  
*Attorney, Agent, or Firm*—Cesari and McKenna, LLP

- [57]
- ABSTRACT**

- A controller for one or more pieces of industrial equipment accommodates multiple sensed conditions—that is, different conditions each associated with a different response, which may be an alarm or a branch control procedure. The controller includes a database of diagnostic templates specifying conditions, and actions or states associated therewith. For example, a template may provide multiple, specified, discrete time spans each reflecting a different machine condition, and each specifying a different action associated with that condition. The templates may be associated with a model of machine behavior, e.g., one based on probabilities, which utilizes the templates and programmed control instructions to simulate machine behavior over time. More broadly, the behavior model may be used to perform a simulated execution of control instructions based on various specified values for limit parameters, which may be provided by the user or computed in accordance with the behavior model (e.g., using a Monte Carlo method) as simulation proceeds.

- 29 Claims, 4 Drawing Sheets**

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- A block diagram illustrating a control system architecture. The diagram is enclosed in a rectangular box labeled 116. Inside the box, three main components are arranged vertically: a 'USER INTERFACE' block (155) at the top, a 'CONTROL BLOCK' (140) in the center, and an 'OPERATING SYSTEM' block (150) at the bottom. Bidirectional vertical arrows connect the 'USER INTERFACE' block to the 'CONTROL BLOCK', and the 'CONTROL BLOCK' to the 'OPERATING SYSTEM' block. On the left side of the box, there are two input ports: a wavy line labeled 145 at the top and a multi-line bus labeled 160 at the bottom. Both of these inputs are connected to the left side of the 'CONTROL BLOCK' (140). A dashed line extends from the bottom of the box 116, indicating a connection to another part of the system.

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